individual_case

Daniel Shang

```r
library(ggplot2)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```r
library(ggthemes)
```

```
## Warning: package 'ggthemes' was built under R version 4.0.3
```

```r
library(ggcorrplot)
library(mefa4)
```

```
## Warning: package 'mefa4' was built under R version 4.0.3

## Loading required package: Matrix

## mefa4 0.3-7    2020-02-28
```

```r
library(e1071)
```

```
## Warning: package 'e1071' was built under R version 4.0.3
```

```r
library(faraway)
```

```
## Warning: package 'faraway' was built under R version 4.0.3
```

```r
data = read.csv('C:/Users/34527/Desktop/dataset.csv')
data_raw = read.csv('C:/Users/34527/Desktop/dataset.csv')
```

—————————————————————— - Data cleaning —————————————————————————-

```r
# Check if there is any missing data in the data set
for (i in 1:ncol(data)) {
  print(paste(colnames(data)[i], ':', sum(is.null(data[, i]))))
  print(paste(colnames(data)[i], ':', sum(data[, i] == 'NA')))
  print(paste(colnames(data)[i], ':', sum(data[, i] == 'N/A')))
  print(paste(colnames(data)[i], ':', sum(data[, i] == '')))
}
```

```
## [1] "id : 0"
## [1] "id : 0"
## [1] "id : 0"
## [1] "id : 0"
## [1] "Gender : 0"
## [1] "Gender : 0"
## [1] "Gender : 0"
## [1] "Gender : 0"
## [1] "Age : 0"
## [1] "Age : 0"
## [1] "Age : 0"
## [1] "Age : 0"
## [1] "Driving_License : 0"
## [1] "Driving_License : 0"
## [1] "Driving_License : 0"
## [1] "Driving_License : 0"
## [1] "Region_Code : 0"
## [1] "Region_Code : 0"
## [1] "Region_Code : 0"
## [1] "Region_Code : 0"
## [1] "Previously_Insured : 0"
## [1] "Previously_Insured : 0"
## [1] "Previously_Insured : 0"
## [1] "Previously_Insured : 0"
## [1] "Vehicle_Age : 0"
## [1] "Vehicle_Age : 0"
## [1] "Vehicle_Age : 0"
## [1] "Vehicle_Age : 0"
## [1] "Vehicle_Damage : 0"
## [1] "Vehicle_Damage : 0"
## [1] "Vehicle_Damage : 0"
## [1] "Vehicle_Damage : 0"
## [1] "Annual_Premium : 0"
## [1] "Annual_Premium : 0"
## [1] "Annual_Premium : 0"
## [1] "Annual_Premium : 0"
## [1] "Policy_Sales_Channel : 0"
## [1] "Policy_Sales_Channel : 0"
## [1] "Policy_Sales_Channel : 0"
## [1] "Policy_Sales_Channel : 0"
## [1] "Vintage : 0"
## [1] "Vintage : 0"
## [1] "Vintage : 0"
## [1] "Vintage : 0"
## [1] "Response : 0"
```

```
## [1] "Response : 0"
## [1] "Response : 0"
## [1] "Response : 0"
```

```r
# Transform categorical variables to dummy variables for easier analysis and better
## model performance
data[data[, 'Vehicle_Damage'] == 'Yes', 'Vehicle_Damage'] = 1
data[data[, 'Vehicle_Damage'] == 'No', 'Vehicle_Damage'] = 0
data[data[, 'Vehicle_Age'] == '< 1 Year', 'Vehicle_Age'] = 0
data[data[, 'Vehicle_Age'] == '1-2 Year', 'Vehicle_Age'] = 1
data[data[, 'Vehicle_Age'] == '> 2 Years', 'Vehicle_Age'] = 2
data[data[, 'Gender'] == 'Female', 'Gender'] = 0
data[data[, 'Gender'] == 'Male', 'Gender'] = 1
```

```r
# Manually remove the data points that is overly unrepresentative. The existance of
## these unrepresentative data points would abort the train/test split and other analysis
to_be_removed = data %>% count(Policy_Sales_Channel) %>%
  group_by(Policy_Sales_Channel) %>% filter(n < 5)
data = data[data$Policy_Sales_Channel %notin% to_be_removed$Policy_Sales_Channel, ]
data = data[, colnames(data) != 'id']
```

──────────────────────── Exploratory Data Analysis ────────────────────────

```r
# A histogram showing the distribution of customer age
ggplot(data = data, aes(Age)) +
  geom_histogram(aes(y=..density..), fill="dodgerblue4", color = 'white', alpha = 0.8,
                 bins = 30) +
  geom_density() +
  labs(title = 'Histogram of Age') +
  theme(plot.title = element_text(hjust = 0.5)) +
  labs(title = 'Histogram of Age') +
  theme_hc()
```

Histogram of Age
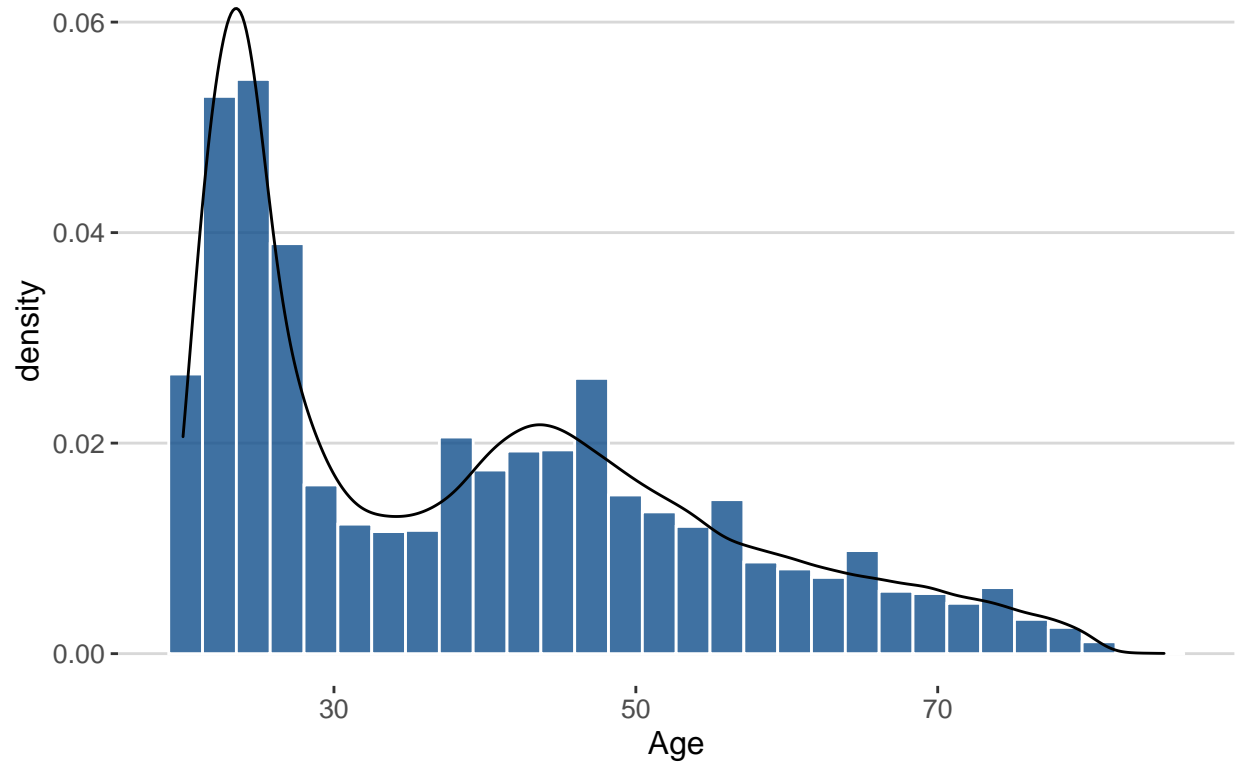

```r
# A histogram showing the distribution of annual premium customers currently pay
ggplot(data = data, aes(Annual_Premium)) +
  geom_histogram(aes(y=..density..), fill="dodgerblue4", color = 'gray', alpha = 0.8,
                 bins = 50) +
  geom_density(adjust = 3) +
  labs(title = 'Histogram of Annual_Premium (in thousand)') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc() +
  scale_x_continuous(labels = function(x){x/10^3})
```

Histogram of Annual_Premium (in thousand)
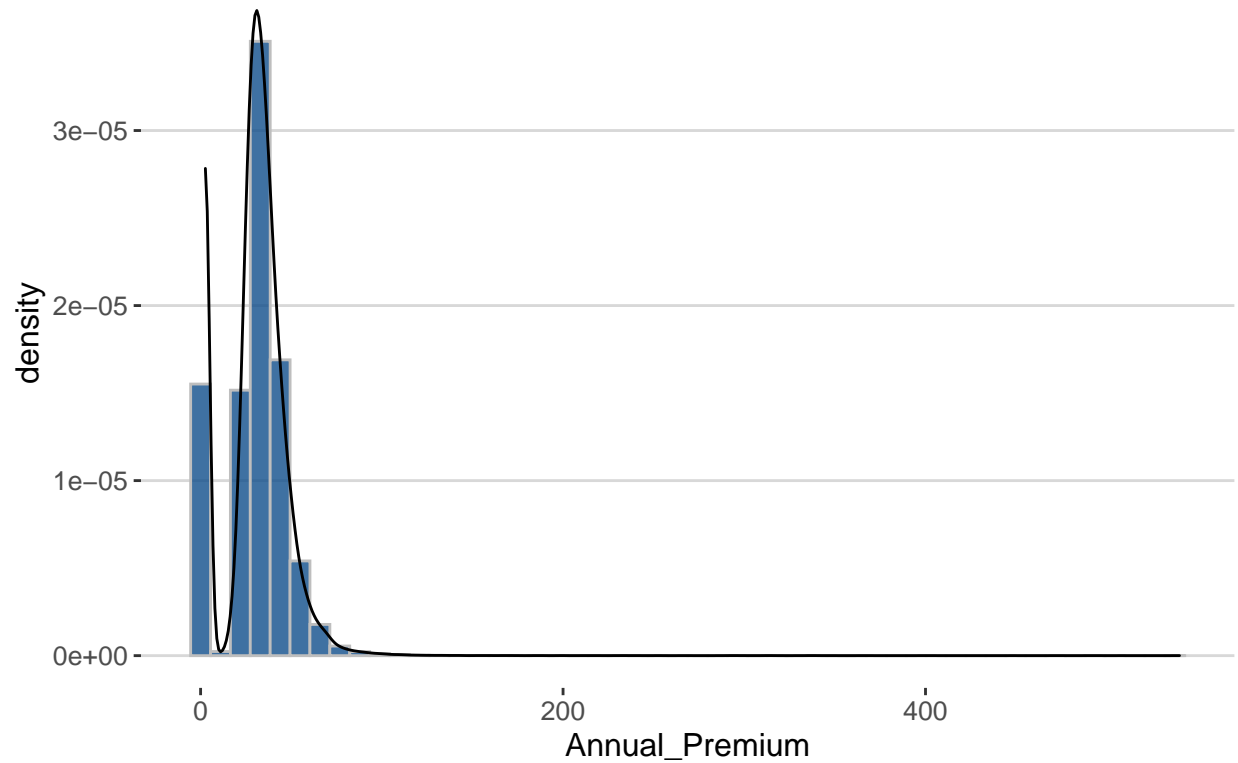

```
# A histogram showing the distribution of customer vintage (the number of days they
## have been associated with the company)
ggplot(data = data, aes(Vintage)) +
  geom_histogram(aes(y=..density..), fill="dodgerblue4", color = 'white', alpha = 0.8,
                 bins = 30) +
  geom_density() +
  labs(title = 'Histogram of Vintage') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

Histogram of Vintage
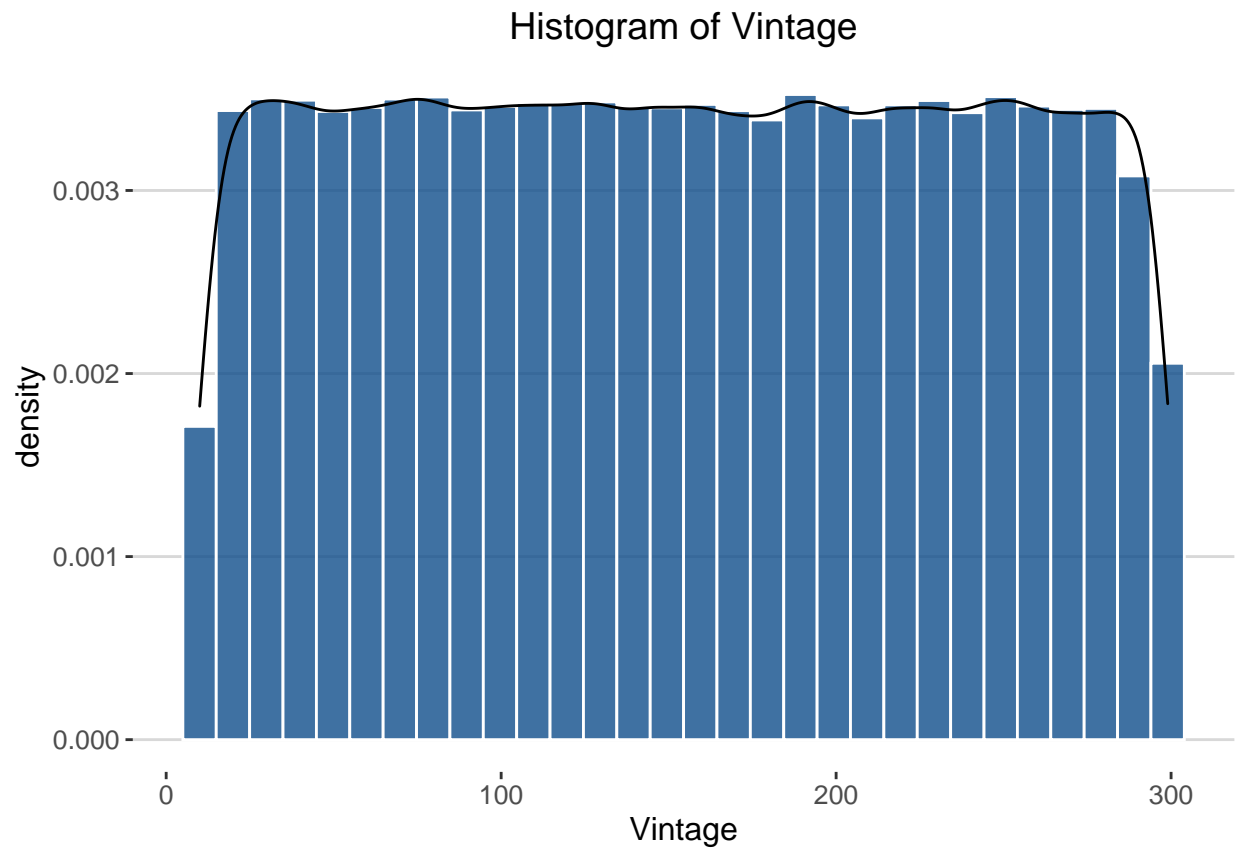

```
# A bar chart showing the number of customers in each gender group
ggplot(data = data, aes(Gender, fill = Gender)) +
  geom_bar(width = 0.5, alpha = 0.8, color = 'white', show.legend = FALSE) +
  labs(title = 'Bar chart of Gender') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

Bar chart of Gender
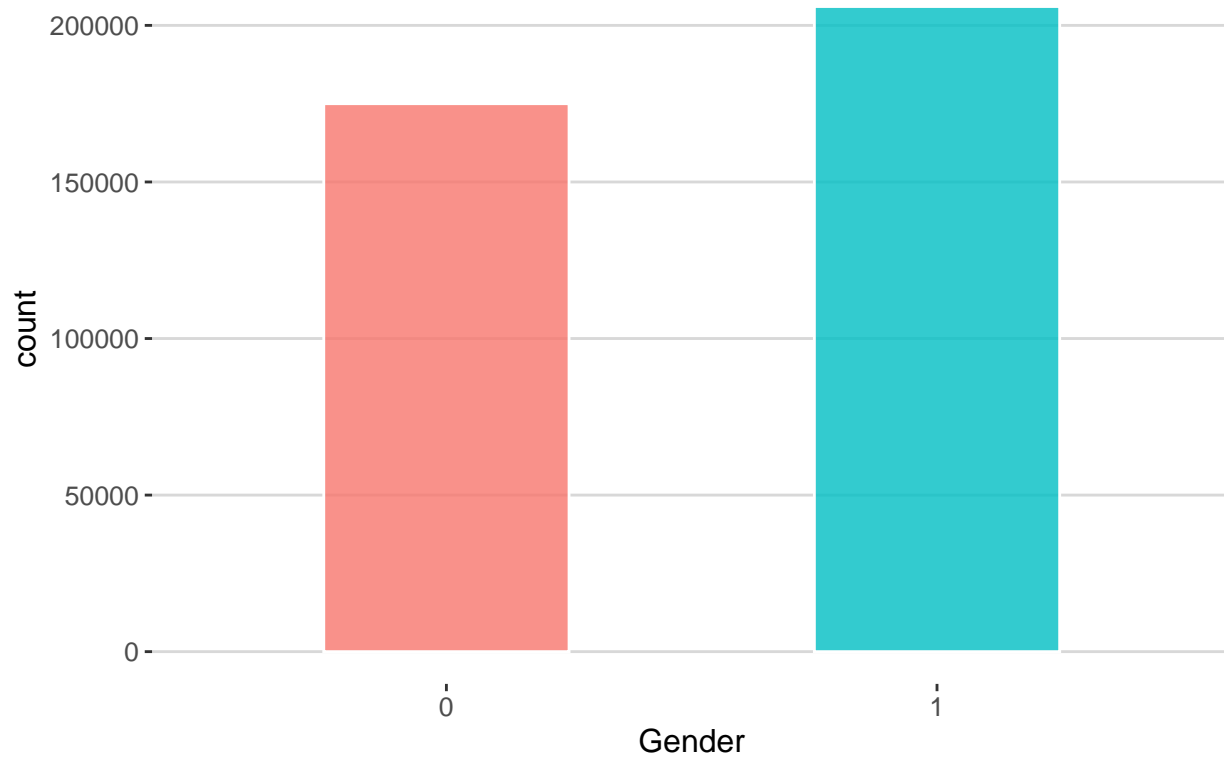

```r
# A bar chart showing the number of customers with and without a driver's license
ggplot(data = data, aes(factor(Driving_License), fill = factor(Driving_License))) +
  geom_bar(width = 0.5, alpha = 0.8, show.legend = FALSE) +
  labs(title = 'Bar chart of Driving_License (in thousand)', x = 'Driving_License') +
  theme(plot.title = element_text(hjust = 0.5), legend.position = 'none') +
  scale_y_continuous(labels = function(y) {y/10^3}) +
  theme_hc()
```

Bar chart of Driving_License (in thousand)
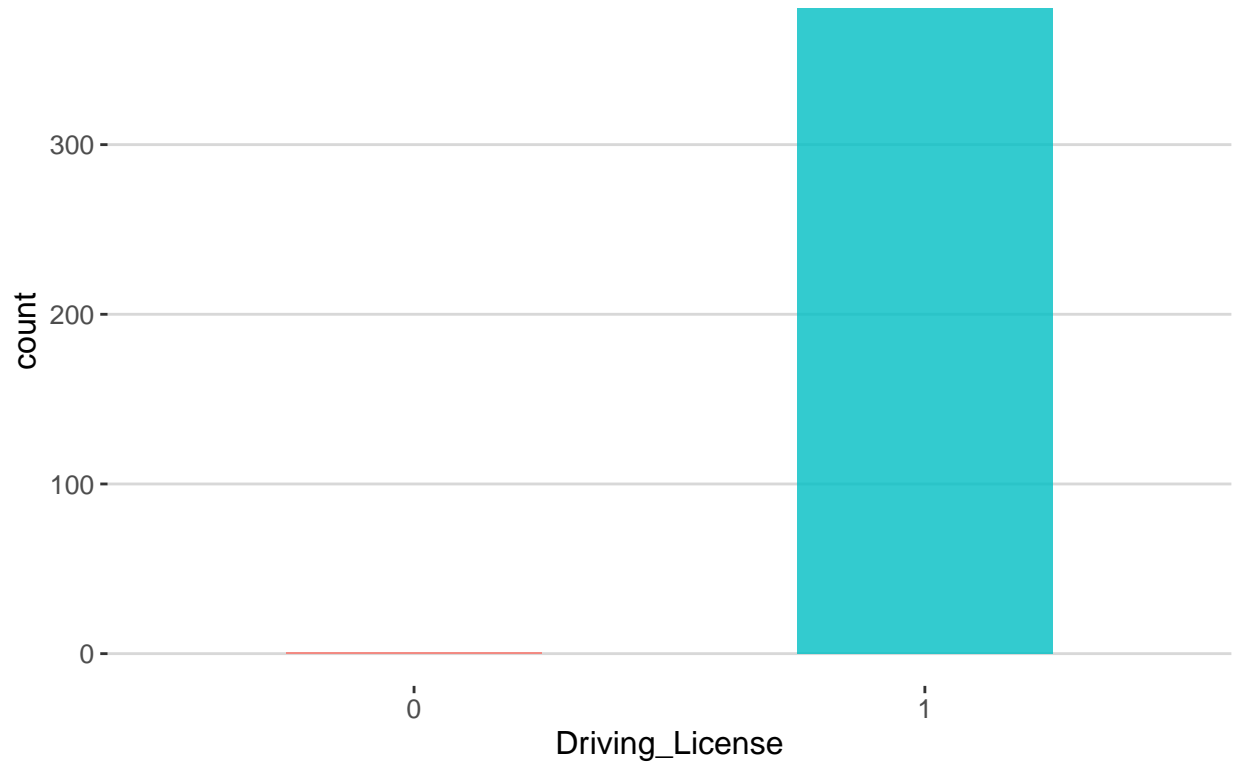

```r
# A bar chart showing the number of customers within each region code
ggplot(data = data, aes(factor(Region_Code), fill = factor(Region_Code))) +
  geom_bar(alpha = 0.8, color = 'white', show.legend = FALSE) +
  labs(title = 'Bar chart of Region_Code', x = 'Region_Code') +
  theme(plot.title = element_text(hjust = 0.5),
        axis.text.x = element_text(angle = 90, hjust = 1, vjust = 0.3)) +
  theme_hc()
```

Bar chart of Region_Code
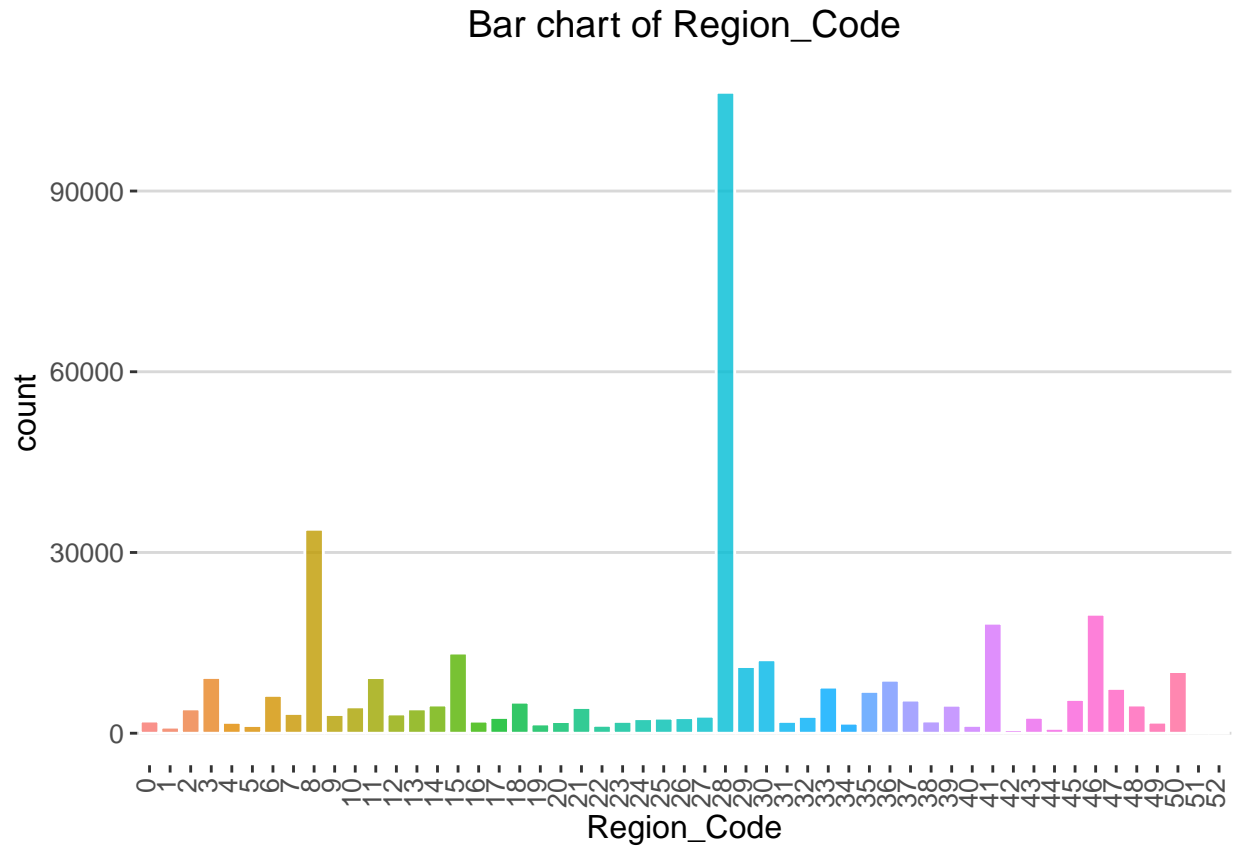

```r
# A bar chart showing the number of customers who are and are not previously insured
ggplot(data = data, aes(factor(Previously_Insured), fill = factor(Previously_Insured))) +
  geom_bar(width = 0.5, alpha = 0.8, color = 'white', show.legend = FALSE) +
  labs(title = 'Bar chart of Previously_Insured', x = 'Previously_Insured') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

Bar chart of Previously_Insured
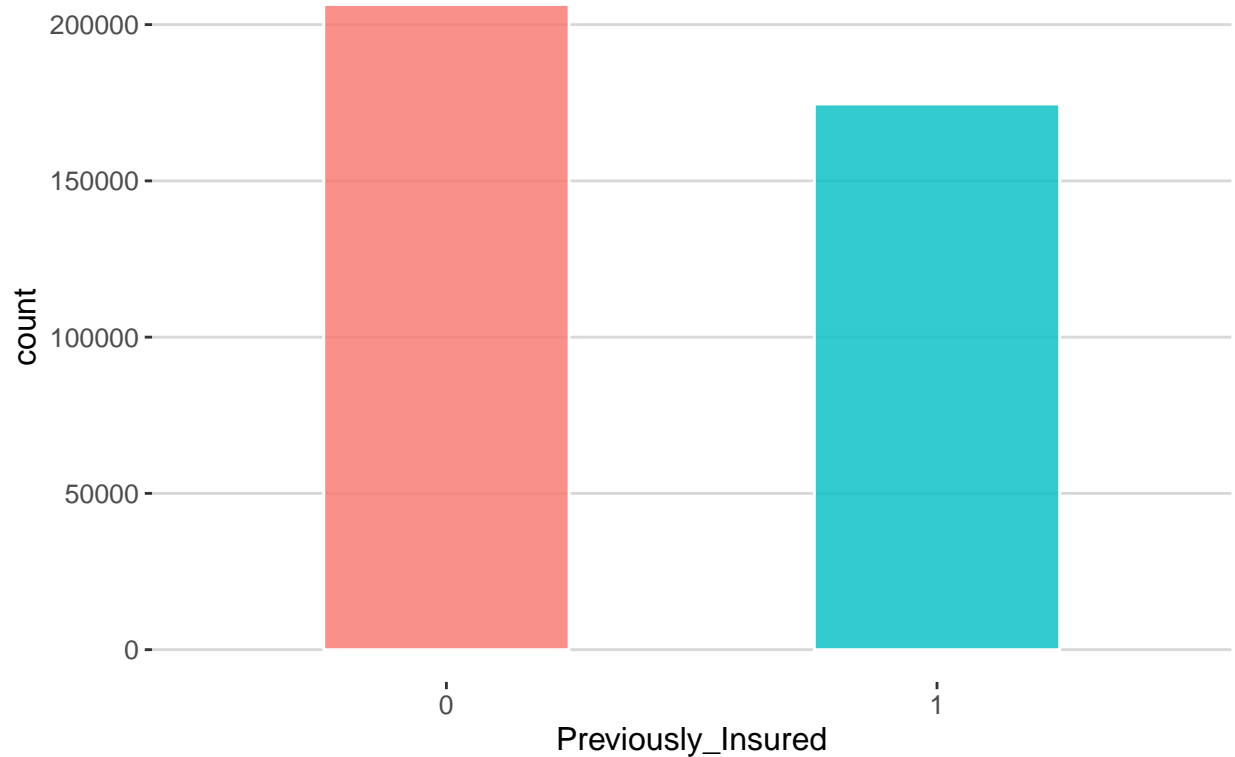

```
# A bar chart showing the count of customers with a vehicle that falls into each of
## the three vehicle age groups
ggplot(data = data, aes(factor(Vehicle_Age, ordered = TRUE, levels = c('0', '1', '2')),
    fill = factor(Vehicle_Age))) +
  geom_bar(width = 0.5, alpha = 0.8, color = 'white', show.legend = FALSE) +
  labs(title = 'Bar chart of Vehicle_Age', x = 'Vehicle_Age') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

Bar chart of Vehicle_Age
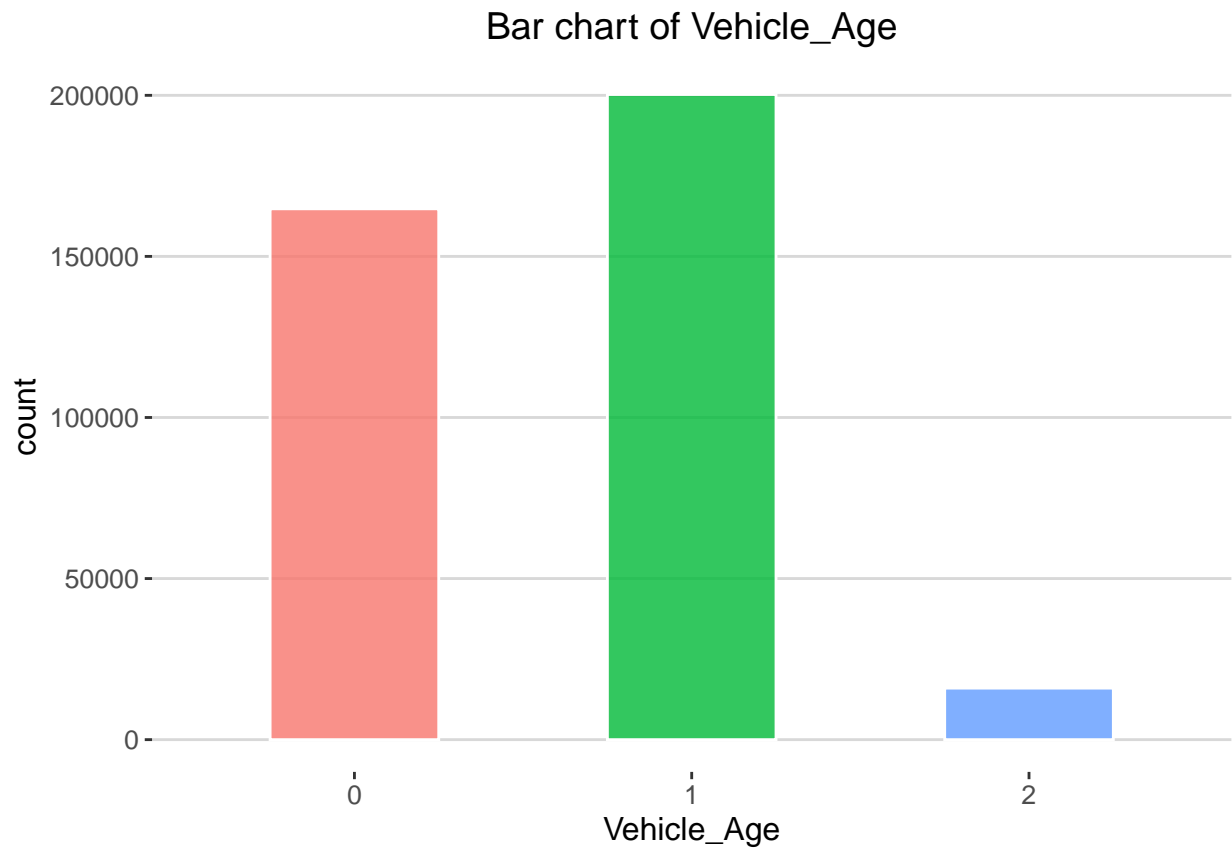

```r
# A bar chart showing the number of customers with and without their vehicle been damaged
ggplot(data = data, aes(Vehicle_Damage, fill = Vehicle_Damage)) +
  geom_bar(width = 0.5, alpha = 0.8, color = 'white', show.legend = FALSE) +
  labs(title = 'Bar chart of Vehicle_Damage') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

# Bar chart of Vehicle_Damage
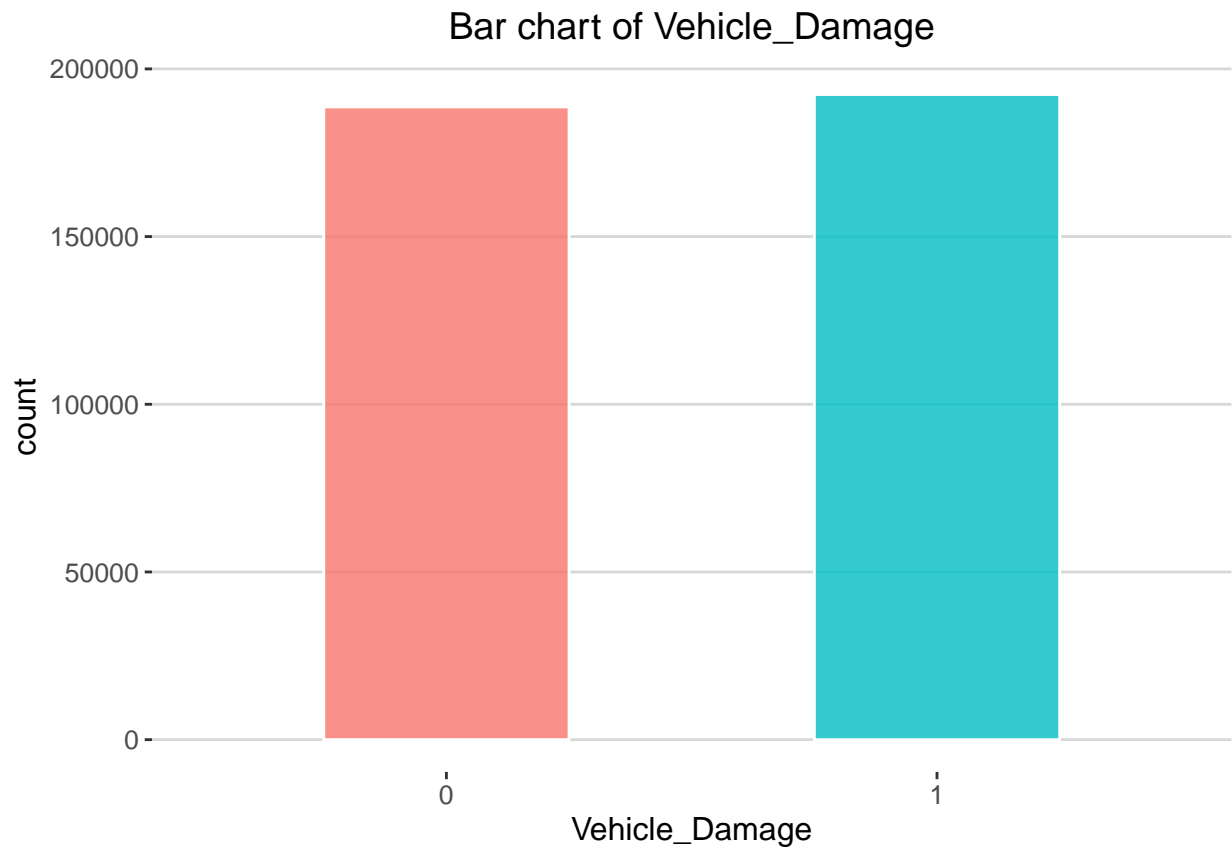

```
# A bar chart showing the number of customers within each policy sales channel
data %>% ggplot(aes(x = reorder(factor(Policy_Sales_Channel),
      Policy_Sales_Channel, function(x) -length(x)),
      fill = factor(Policy_Sales_Channel))) +
  geom_bar(alpha = 0.8, color = 'white', show.legend = FALSE) +
  labs(title = 'Bar chart of Policy_Sales_Channel (High to low in thousand)',
      x = 'Policy_Sales_Channel') +
  theme(axis.text.x = element_text(hjust = 1, angle = 90, vjust = 0.3, size = 7.5)) +
  scale_y_continuous(labels = function(y) {y/10^3}) +
  theme_hc()
```

Bar chart of Policy_Sales_Channel (High to low in thousand)
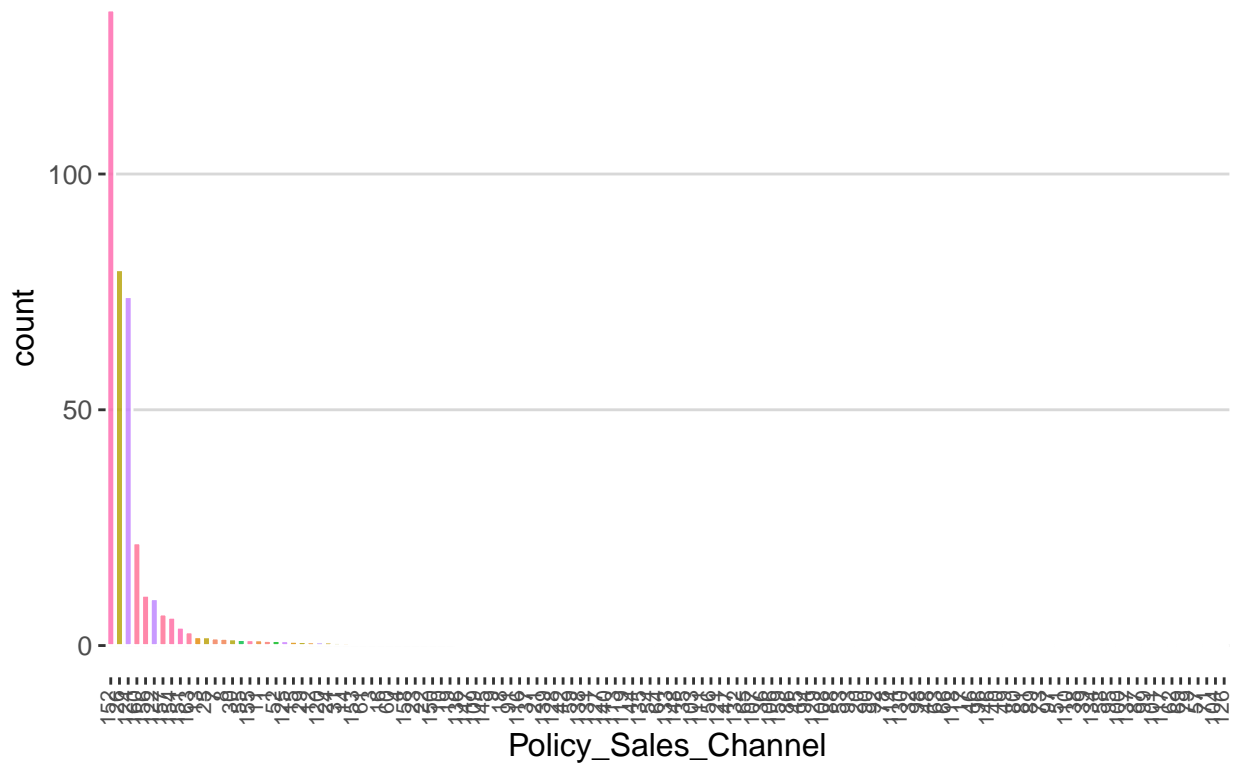

```
# A bar chart showing the count of customers' response
ggplot(data = data, aes(factor(Response), fill = factor(Response))) +
  geom_bar(stat = 'count', width = 0.5, alpha = 0.8, color = 'white', show.legend = FALSE) +
  labs(title = 'Bar chart of customer response', x = 'Response', y = 'count (in thousand)') +
  scale_y_continuous(labels = function(y) {y / 1000}) +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

Bar chart of customer response
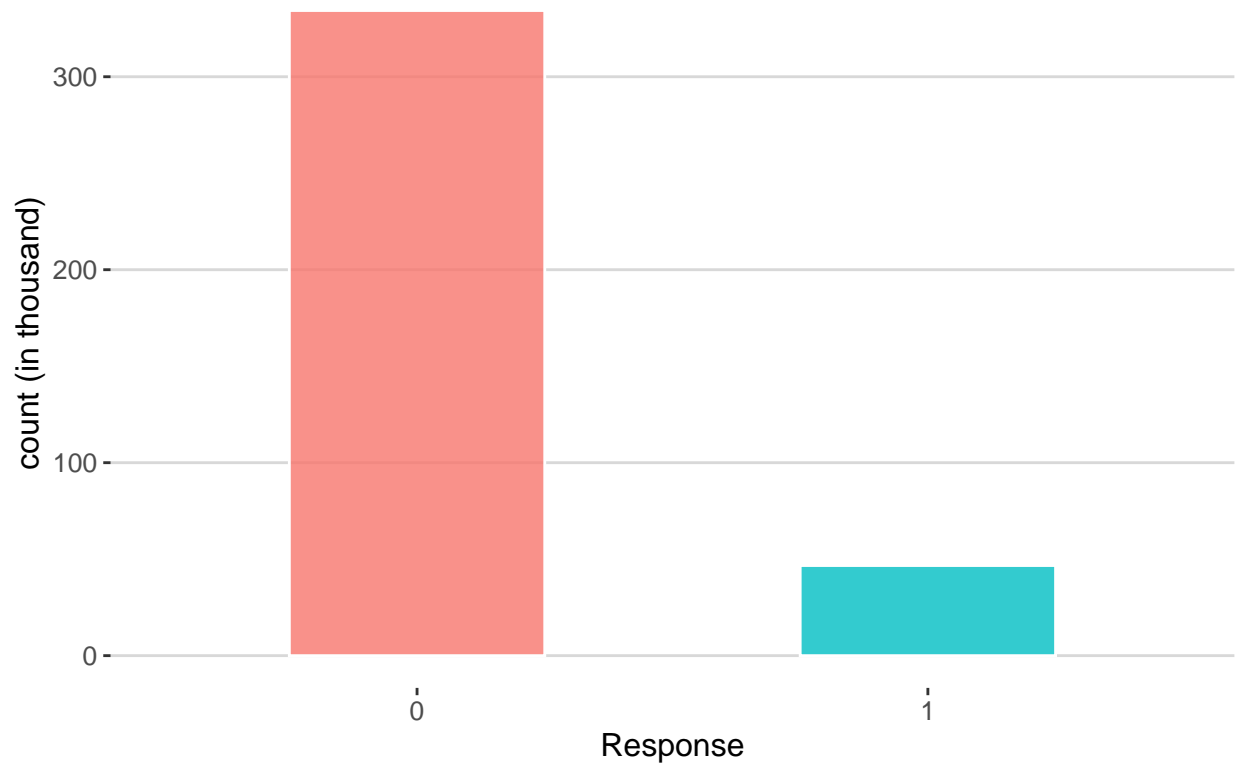

```
# A stacked bar chart showing, within each customer response group, what percentage
## of customers is male and female
ggplot(data, aes(factor(Response), fill = factor(Gender))) +
  geom_bar(width = 0.5, alpha = 0.8, position = 'fill', color = 'white') +
  scale_y_continuous(labels = scales::percent) +
  labs(x = 'Customer response', title = 'Customer response combined with gender') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```
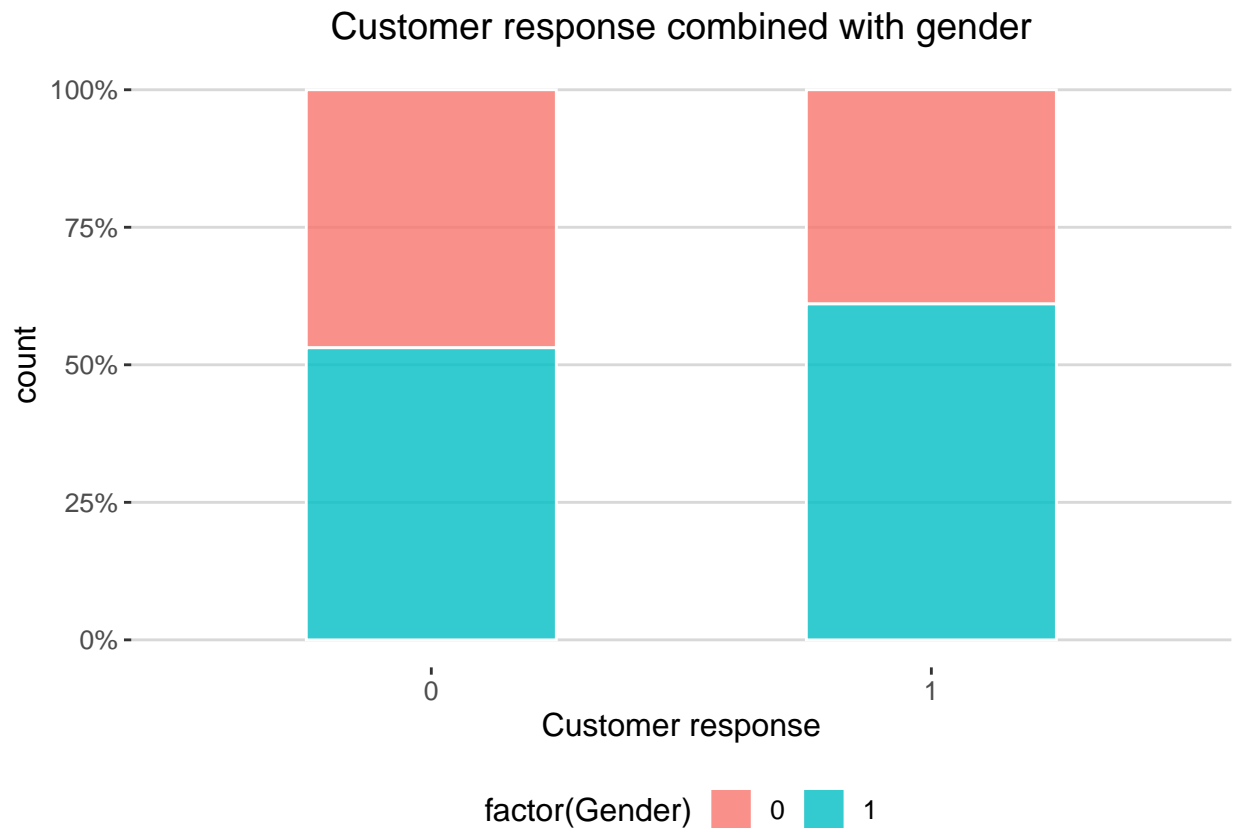
Customer response combined with gender


```r
# A stacked bar chart showing, within each customer response group, what percentage
## of customers have or do not have a driver's license. Since most customers have a
## driver's license, the pink part is invisible
ggplot(data, aes(x = factor(Response), fill = factor(Driving_License))) +
  geom_bar(width = 0.5, alpha = 0.8, position = 'fill', color = 'white') +
  scale_y_continuous(labels = scales::percent) +
  labs(x = 'Customer response',
       title = 'Customer response combined with drivering license') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

Customer response combined with drivering license
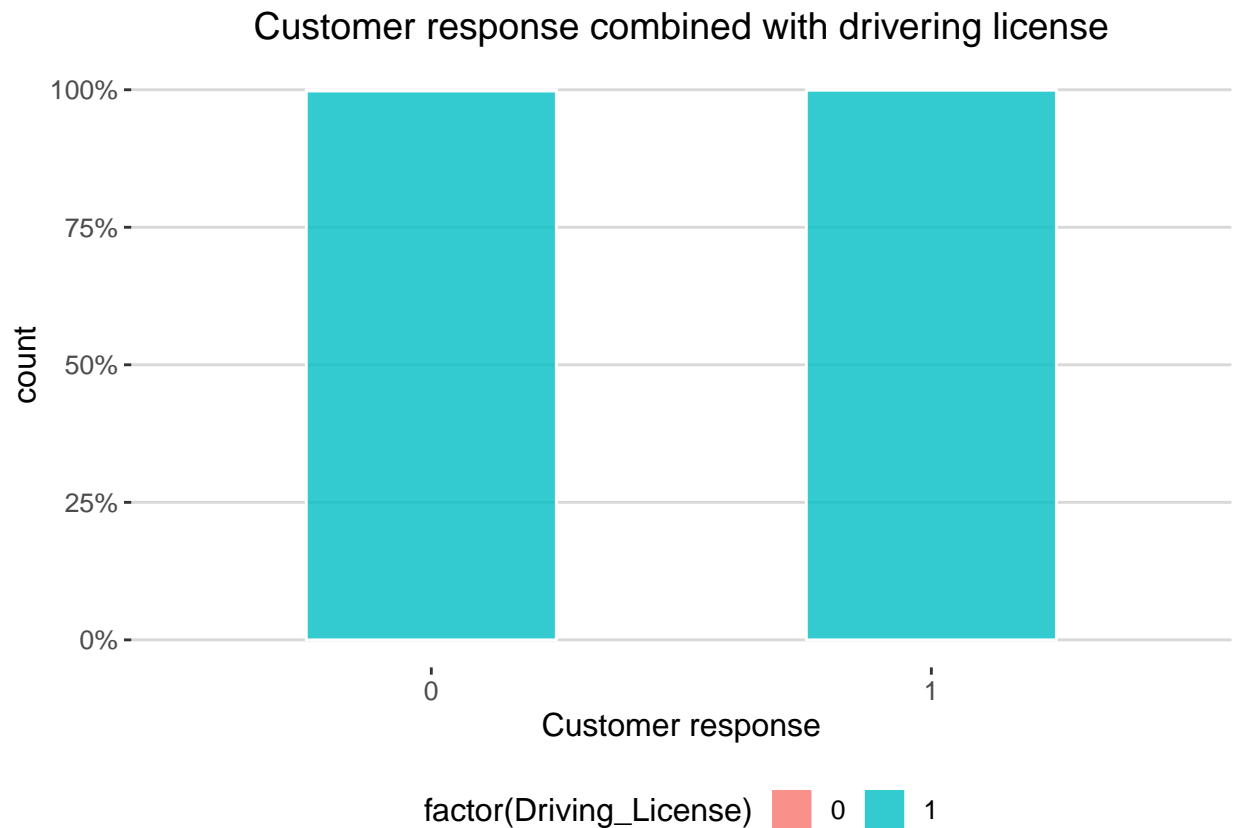

```r
# A stacked bar chart showing, within each customer response group, what percentage of
## customers are previously insured
ggplot(data = data, aes(factor(Response), fill = factor(Previously_Insured))) +
  geom_bar(width = 0.5, alpha = 0.8, position = 'fill', color = 'white') +
  scale_y_continuous(labels = scales::percent) +
  labs(x='Customer response', title = 'Customer response combined with previously insured') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

Customer response combined with previously insured
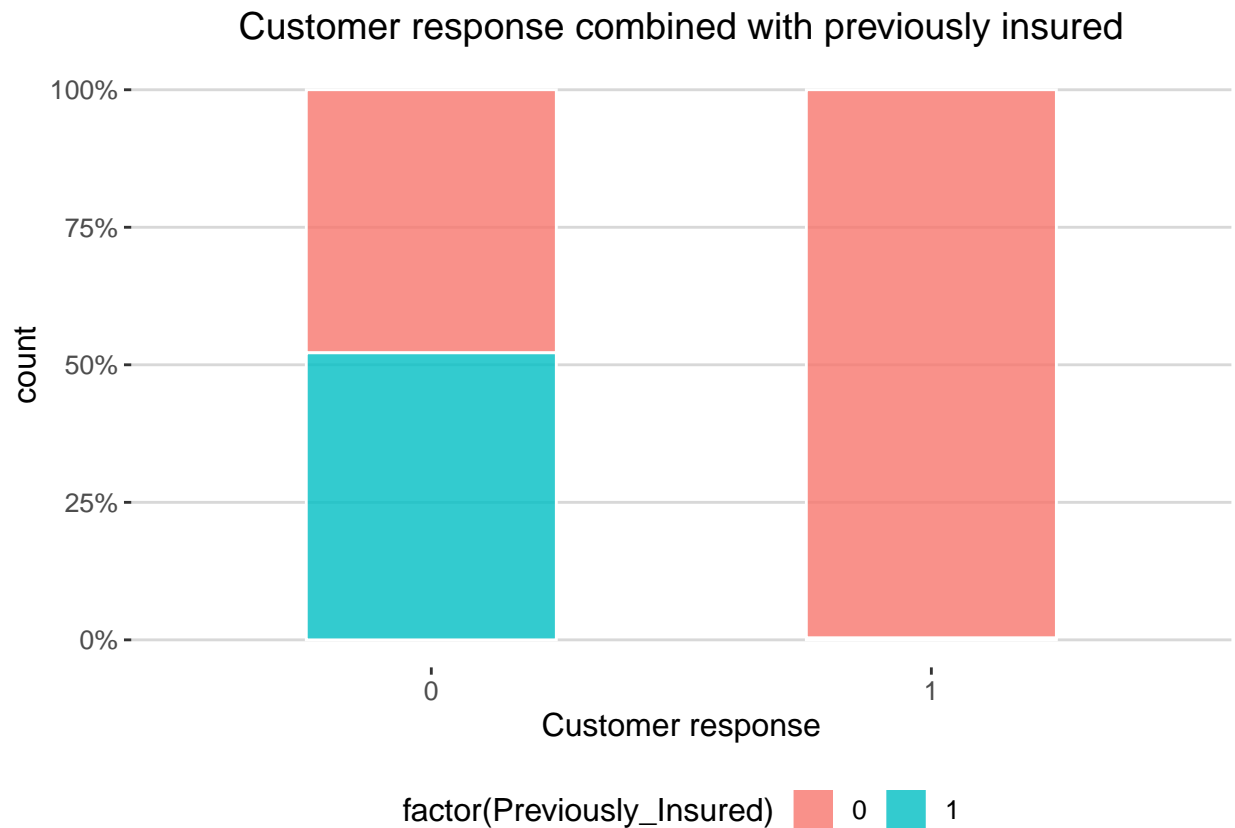

```
# A stacked bar chart showing, within each customer response group, what percentage of
## customers have their vehicle damaged before
ggplot(data, aes(x = factor(Response), fill = factor(Vehicle_Damage))) +
  geom_bar(width = 0.5, alpha = 0.8, position = 'fill', color = 'white') +
  scale_y_continuous(labels = scales::percent) +
  labs(x = 'Customer response', title =
        'Customer response combined with Vehicle_damage') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```
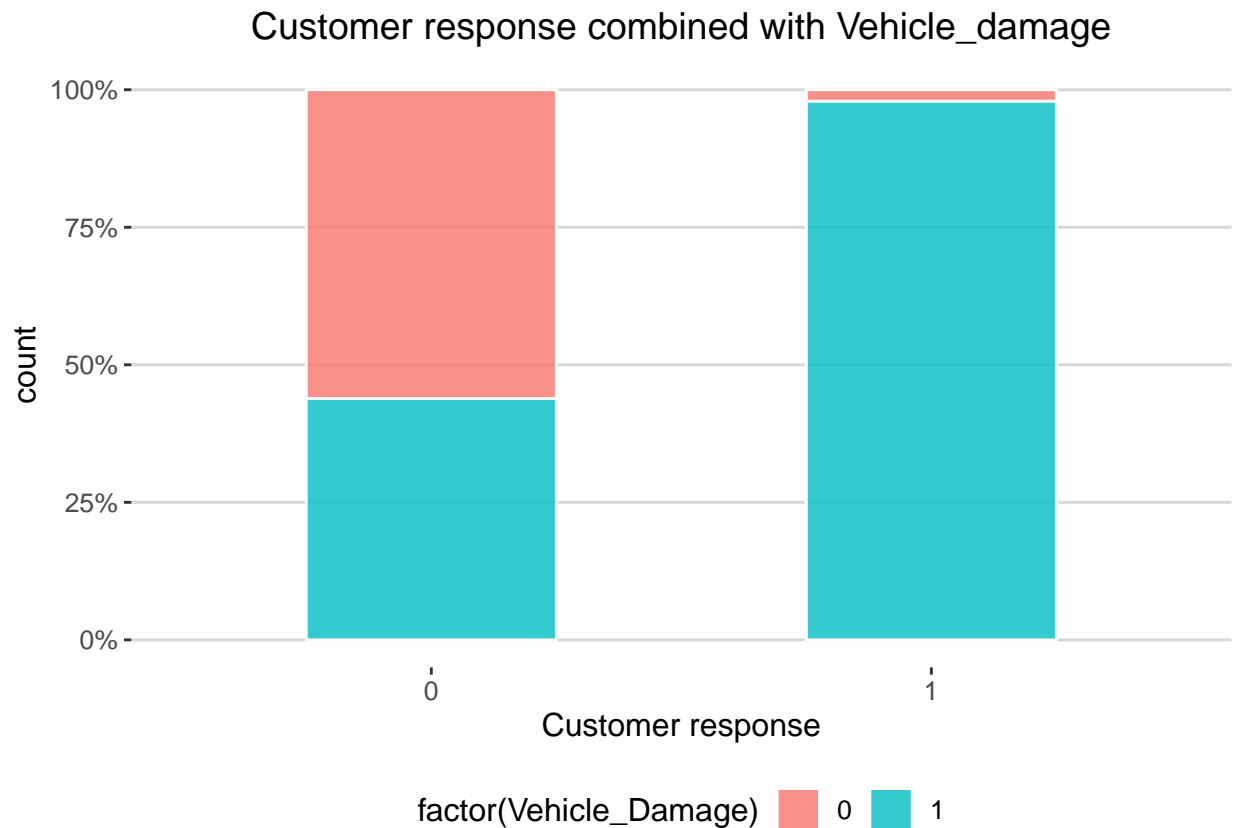
Customer response combined with Vehicle_damage


```
# A stacked bar chart showing, within each customer response group, what percentage of
## customers have a vehicle with an age below one year, from one to two years, and over
## two years respectively
ggplot(data, aes(x = factor(Response), fill = factor(Vehicle_Age))) +
  geom_bar(width = 0.5, alpha = 0.8, position = 'fill', color = 'white') +
  scale_y_continuous(labels = scales::percent) +
  labs(title = 'Customer response combined with vehicle age') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

Customer response combined with vehicle age
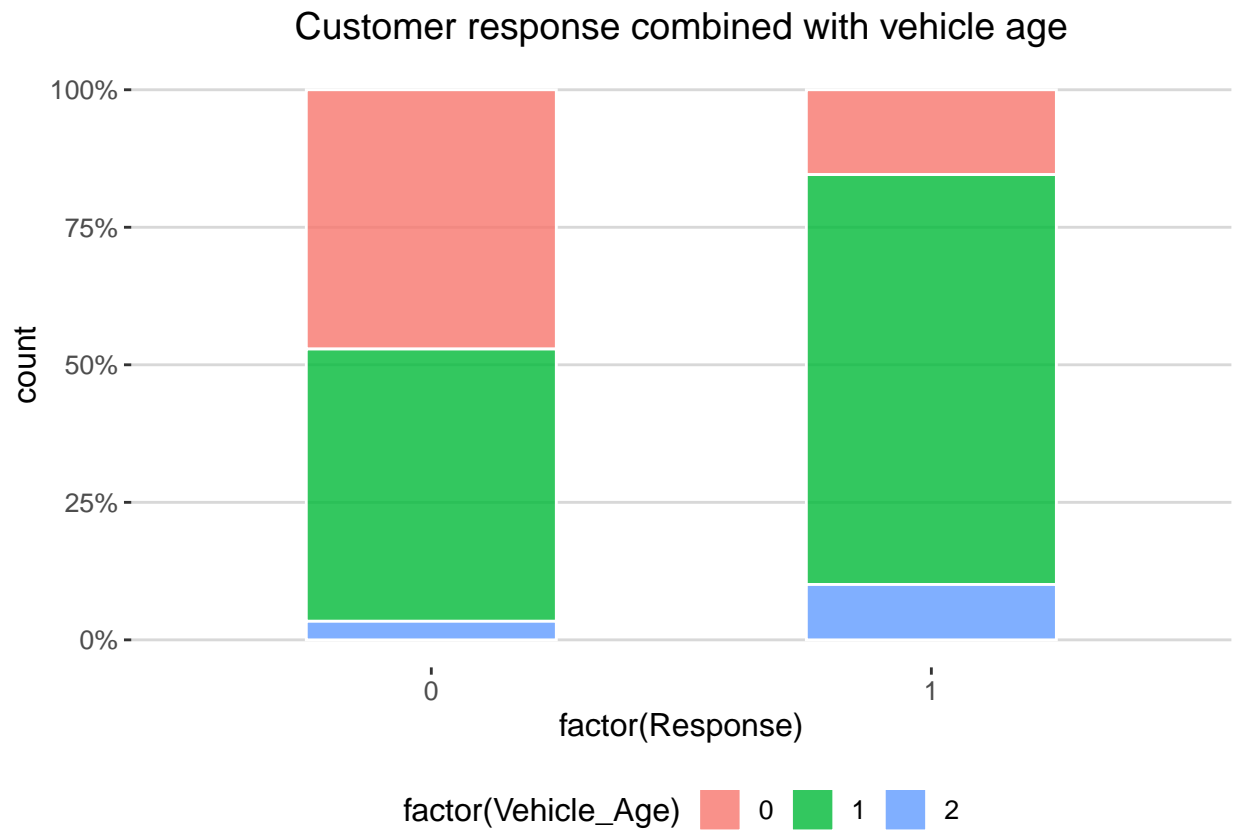

```r
# A density plot showing how customers' ages are distributed within each response
## group
ggplot(data, aes(x = Age, fill = factor(Response))) +
  geom_density(alpha = 0.8) +
  labs(title = 'Customer response by age') +
  scale_y_continuous(labels = scales::percent) +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

Customer response by age


```r
# A histogram showing how customers' annual premiums are distributed within each
## response group
ggplot(data, aes(x = Annual_Premium, fill = factor(Response))) +
  geom_histogram(alpha = 0.8, color = 'black') +
  geom_density() +
  labs(title = 'Customer response by annual premium paid (0 - 100K)',
       x = 'Annual_Premium (in thousand)') +
  scale_x_continuous(labels = function(x) {x / 1000}) +
  theme(plot.title = element_text(hjust = 0.5)) +
  xlim(0, 100000) +
  theme_hc()
```

```
## Scale for 'x' is already present. Adding another scale for 'x', which will
## replace the existing scale.
```

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

```
## Warning: Removed 777 rows containing non-finite values (stat_bin).
```

```
## Warning: Removed 777 rows containing non-finite values (stat_density).
```

```
## Warning: Removed 4 rows containing missing values (geom_bar).
```

Customer response by annual premium paid (0 – 100K)
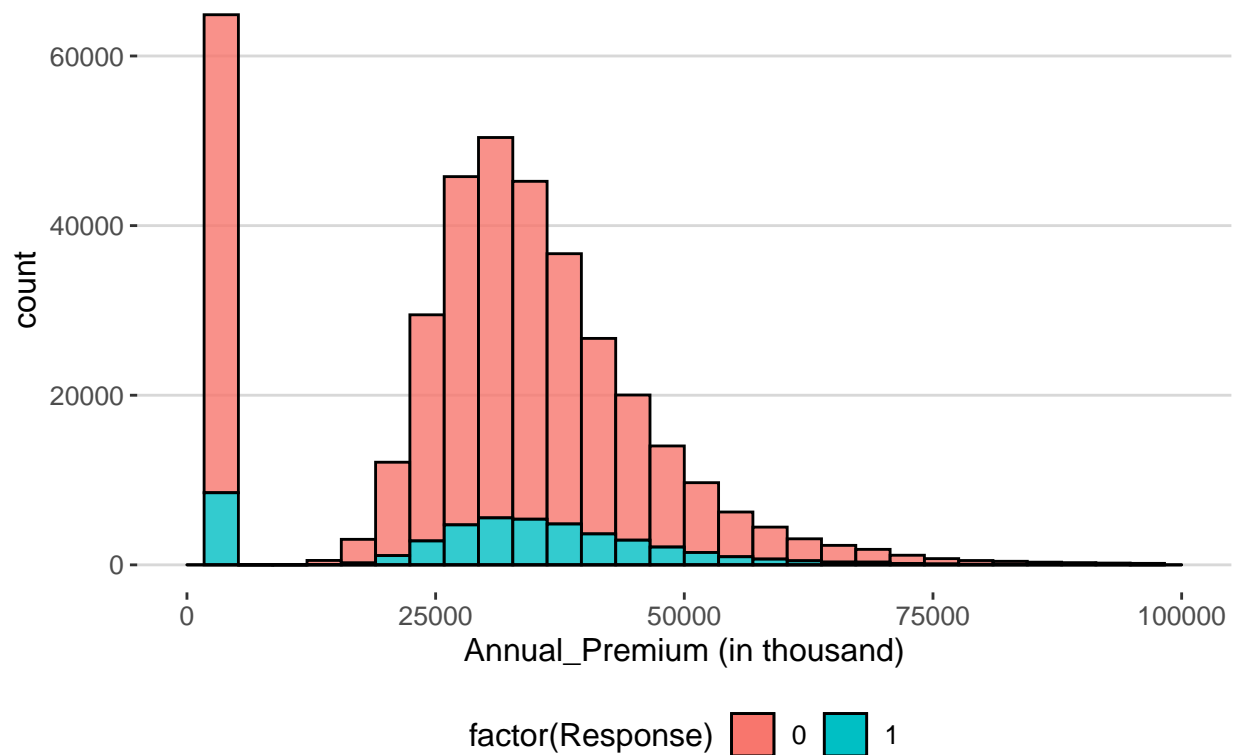

```
# A density plot showing how customers' vintages are distributed within each response
## group
ggplot(data, aes(Vintage, fill = factor(Response))) +
  geom_density(alpha = 0.8) +
  scale_y_continuous(labels = scales::percent) +
  labs(title = 'Customer response by vintage') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

Customer response by vintage
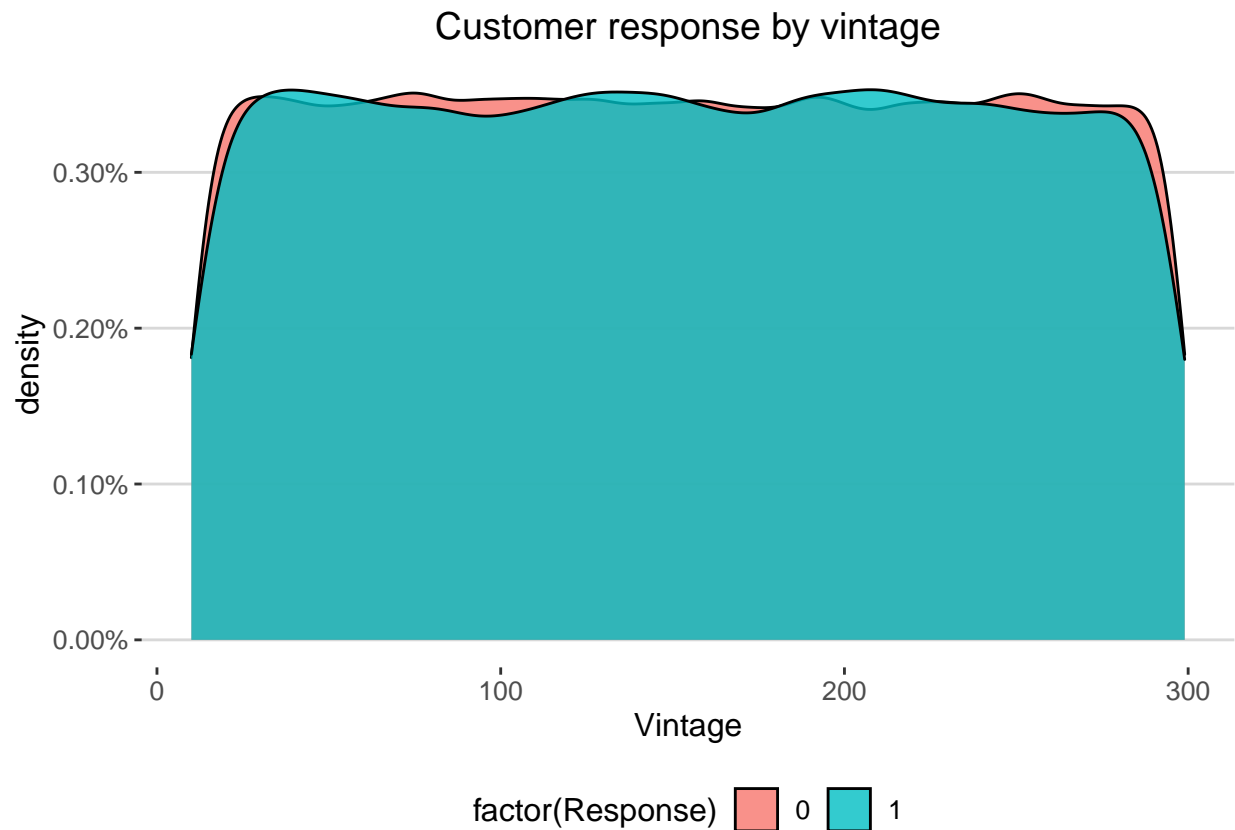

```
# A density plot showing how customers of different response group are distributed
## within the country
ggplot(data, aes(x = Region_Code, fill = factor(Response))) +
  geom_density(alpha = 0.8) +
  scale_y_continuous(labels = scales::percent) +
  labs(title = 'Customer response by region code') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

Customer response by region code
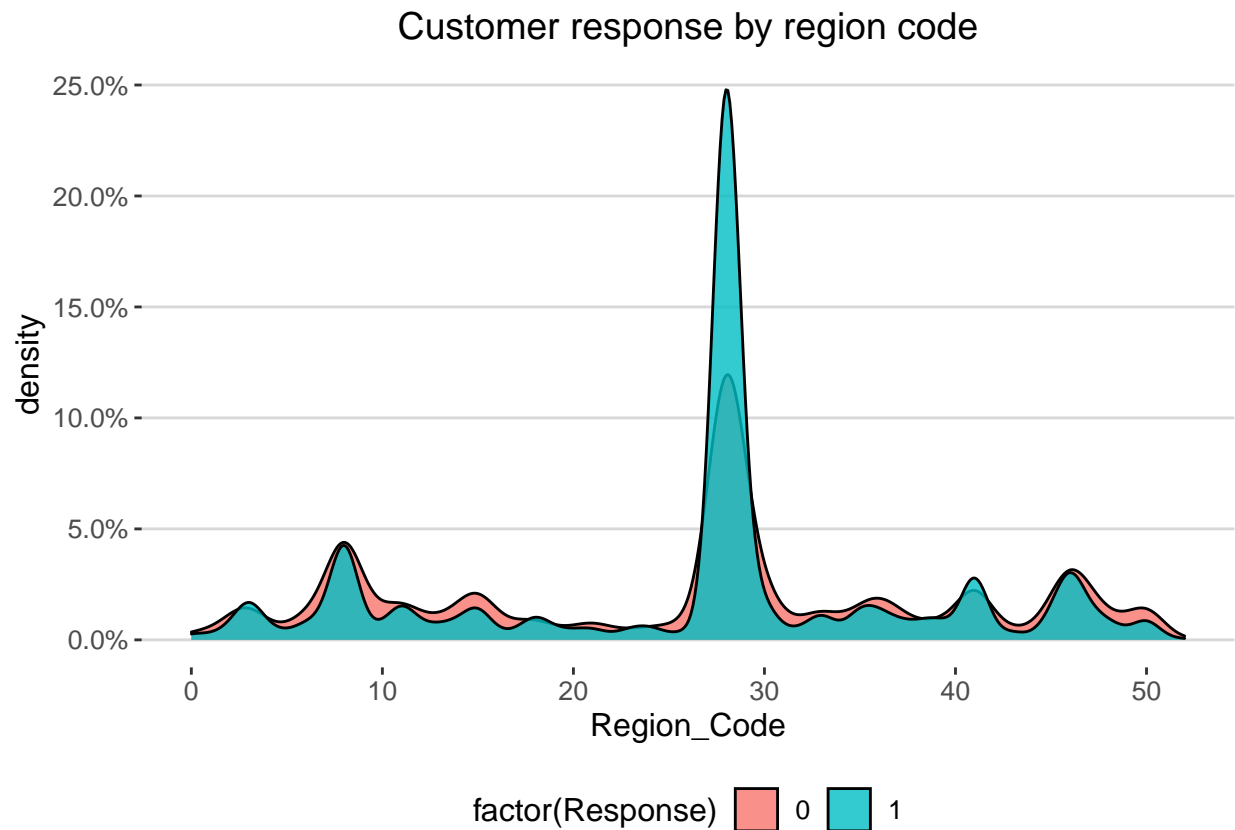

```r
# A density plot showing how customers within each response group are distributed
## among different policy sales channel
ggplot(data, aes(x = Policy_Sales_Channel, fill = factor(Response))) +
  geom_density(alpha = 0.8) +
  scale_y_continuous(labels = scales::percent) +
  labs(title = 'Customer response by policy sales channel') +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme_hc()
```

Customer response by policy sales channel
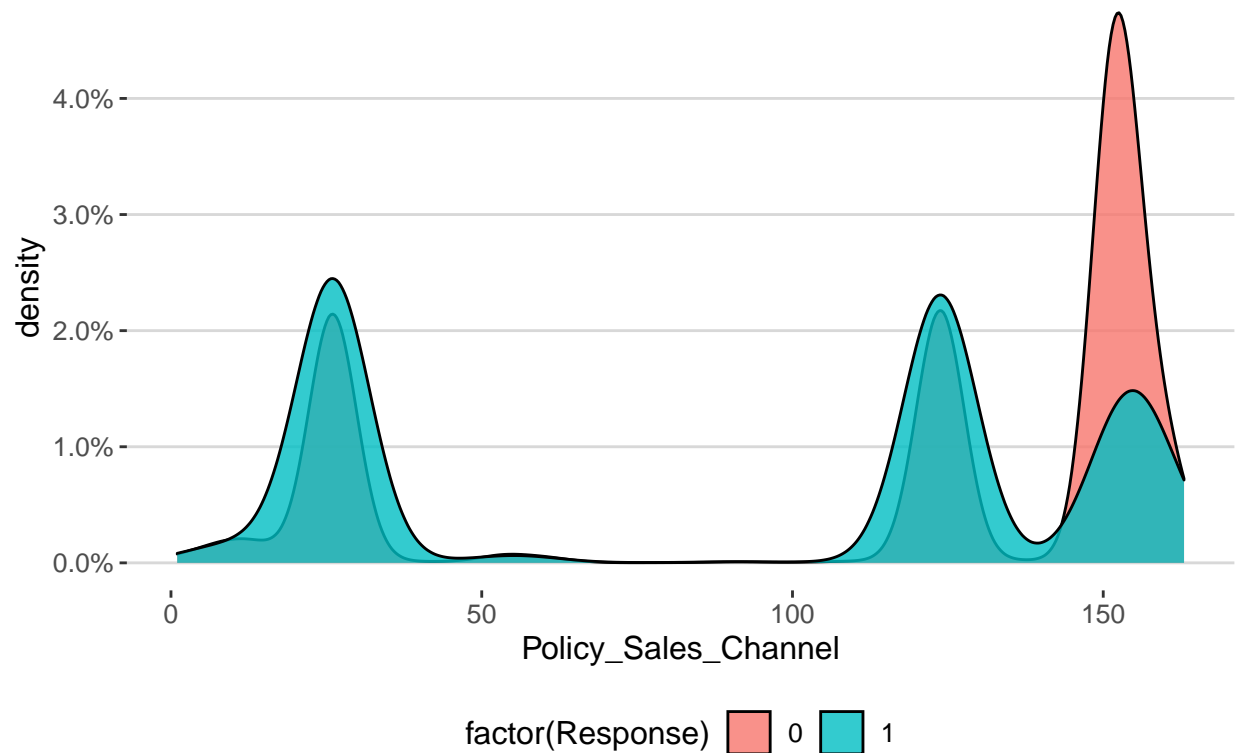

```r
# A correlation matrix showing the correlation between each pair of the variables
data_matrix = data
for (i in 1:ncol(data_matrix)) {
  data_matrix[, i] = as.numeric(data_matrix[, i])
}

ggcorrplot(cor(data_matrix), method = 'square', type = 'full', lab = TRUE,
      ggtheme = theme_void, lab_size = 2.5, outline.color = 'black',
      color = c('blue', 'white', 'red'), title = 'Correlation matrix') +
  theme(plot.title = element_text(hjust = 0.5))
```

Correlation matrix

	Gender	Age	Driving_License	Region_Code	Previously_Insured	Vehicle_Age	Vehicle_Damage	Annual_Premium	Policy_Sales_Channel	Vintage	Response
Response	0.05	0.11	0.01	0.01	−0.34	0.22	0.35	0.02	−0.14	0	1
Vintage	0	0	0	0	0	0	0	0	0	1	0
Policy_Sales_Channel	−0.11	−0.58	0.04	−0.04	0.22	−0.55	−0.22	−0.11	1	0	−0.14
Annual_Premium	0	0.07	−0.01	−0.01	0	0.04	0.01	1	−0.11	0	0.02
Vehicle_Damage	0.09	0.27	−0.02	0.03	−0.82	0.4	1	0.01	−0.22	0	0.35
Vehicle_Age	0.16	0.77	−0.04	0.04	−0.38	1	0.4	0.04	−0.55	0	0.22
Previously_Insured	−0.08	−0.25	0.01	−0.02	1	−0.38	−0.82	0	0.22	0	−0.34
Region_Code	0	0.04	0	1	−0.02	0.04	0.03	−0.01	−0.04	0	0.01
Driving_License	−0.02	−0.08	1	0	0.01	−0.04	−0.02	−0.01	0.04	0	0.01
Age	0.15	1	−0.08	0.04	−0.25	0.77	0.27	0.07	−0.58	0	0.11
Gender	1	0.15	−0.02	0	−0.08	0.16	0.09	0	−0.11	0	0.05

Corr
1.0
0.5
0.0
−0.5
−1.0

———————————— - Logistic Regression Model ————————————-

```
# Build a logistic regression model based on previous analysis
options(max.print=1000000)
glm1 = glm(Response ~ Gender +
            Age * Vehicle_Age +
            factor(Driving_License) +
            factor(Region_Code) +
            factor(Vehicle_Damage) * factor(Previously_Insured) +
            Annual_Premium +
            factor(Policy_Sales_Channel) * Age,
        data = data,
        family = "binomial")
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
summary(glm1)
```

```
##
## Call:
## glm(formula = Response ~ Gender + Age * Vehicle_Age + factor(Driving_License) +
##     factor(Region_Code) + factor(Vehicle_Damage) * factor(Previously_Insured) +
##     Annual_Premium + factor(Policy_Sales_Channel) * Age, family = "binomial",
##     data = data)
##
```

```
## Deviance Residuals:
##     Min      1Q   Median      3Q     Max
## -2.9177  -0.6060  -0.0393  -0.0231   4.3458
##
## Coefficients:
##                                          Estimate Std. Error
## (Intercept)                             -5.732e+00  6.238e-01
## Gender1                                  6.477e-02  1.137e-02
## Age                                      5.182e-03  1.401e-02
## Vehicle_Age1                             4.044e+00  1.251e-01
## Vehicle_Age2                             4.114e+00  1.521e-01
## factor(Driving_License)1                 1.129e+00  1.642e-01
## factor(Region_Code)1                     2.317e-01  1.350e-01
## factor(Region_Code)2                     5.768e-01  1.070e-01
## factor(Region_Code)3                     9.322e-01  9.051e-02
## factor(Region_Code)4                     8.792e-01  1.100e-01
## factor(Region_Code)5                     7.723e-01  1.267e-01
## factor(Region_Code)6                     9.327e-01  1.010e-01
## factor(Region_Code)7                     7.023e-01  1.007e-01
## factor(Region_Code)8                     5.882e-01  8.614e-02
## factor(Region_Code)9                     4.127e-01  1.094e-01
## factor(Region_Code)10                    7.024e-01  1.095e-01
## factor(Region_Code)11                    1.122e+00  9.204e-02
## factor(Region_Code)12                    7.491e-01  1.068e-01
## factor(Region_Code)13                    7.025e-01  1.031e-01
## factor(Region_Code)14                    8.107e-01  1.015e-01
## factor(Region_Code)15                    5.772e-01  9.156e-02
## factor(Region_Code)16                    6.055e-01  1.280e-01
## factor(Region_Code)17                    4.763e-01  1.181e-01
## factor(Region_Code)18                    1.022e+00  9.607e-02
## factor(Region_Code)19                    7.321e-01  1.121e-01
## factor(Region_Code)20                    3.424e-01  1.123e-01
## factor(Region_Code)21                    8.537e-01  1.076e-01
## factor(Region_Code)22                    3.529e-01  1.479e-01
## factor(Region_Code)23                    8.905e-01  1.091e-01
## factor(Region_Code)24                    7.841e-01  1.062e-01
## factor(Region_Code)25                    2.454e-01  1.348e-01
## factor(Region_Code)26                    3.158e-01  1.184e-01
## factor(Region_Code)27                    6.007e-01  1.138e-01
## factor(Region_Code)28                    8.243e-01  8.409e-02
## factor(Region_Code)29                    1.064e+00  9.002e-02
## factor(Region_Code)30                    9.258e-01  9.258e-02
## factor(Region_Code)31                    3.846e-01  1.180e-01
## factor(Region_Code)32                    8.275e-01  1.120e-01
## factor(Region_Code)33                    7.087e-01  9.383e-02
## factor(Region_Code)34                    4.183e-01  1.295e-01
## factor(Region_Code)35                    1.032e+00  9.384e-02
## factor(Region_Code)36                    6.624e-01  9.407e-02
## factor(Region_Code)37                    6.439e-01  9.980e-02
## factor(Region_Code)38                    9.213e-01  1.037e-01
## factor(Region_Code)39                    6.133e-01  9.661e-02
## factor(Region_Code)40                    6.206e-01  1.247e-01
## factor(Region_Code)41                    1.009e+00  8.775e-02
## factor(Region_Code)42                    3.331e-01  1.871e-01
```

```
## factor(Region_Code)43                        4.414e-01  1.105e-01
## factor(Region_Code)44                        1.112e-01  2.099e-01
## factor(Region_Code)45                        7.820e-01  9.607e-02
## factor(Region_Code)46                        7.354e-01  8.755e-02
## factor(Region_Code)47                        5.296e-01  9.505e-02
## factor(Region_Code)48                        2.204e-01  9.907e-02
## factor(Region_Code)49                        4.494e-01  1.265e-01
## factor(Region_Code)50                        3.396e-01  9.595e-02
## factor(Region_Code)51                        8.009e-01  2.401e-01
## factor(Region_Code)52                        6.866e-01  2.209e-01
## factor(Vehicle_Damage)1                      1.925e+00  3.497e-02
## factor(Previously_Insured)1                 -4.346e+00  1.230e-01
## Annual_Premium                               1.383e-06  3.433e-07
## factor(Policy_Sales_Channel)3               -1.455e+00  8.034e-01
## factor(Policy_Sales_Channel)4               -3.064e+00  8.938e-01
## factor(Policy_Sales_Channel)7               -9.621e-01  7.293e-01
## factor(Policy_Sales_Channel)8               -2.519e+00  7.518e-01
## factor(Policy_Sales_Channel)9               -7.756e-01  1.621e+00
## factor(Policy_Sales_Channel)10              -1.588e+00  1.057e+00
## factor(Policy_Sales_Channel)11              -1.431e+00  8.001e-01
## factor(Policy_Sales_Channel)12              -8.476e-01  7.862e-01
## factor(Policy_Sales_Channel)13              -2.299e+00  6.847e-01
## factor(Policy_Sales_Channel)14              -1.765e+00  8.843e-01
## factor(Policy_Sales_Channel)15              -2.636e+00  8.368e-01
## factor(Policy_Sales_Channel)16              -1.465e+00  9.358e-01
## factor(Policy_Sales_Channel)17               7.760e-01  3.732e+00
## factor(Policy_Sales_Channel)18              -2.394e+00  2.173e+00
## factor(Policy_Sales_Channel)19              -1.589e+00  1.503e+00
## factor(Policy_Sales_Channel)20               1.035e+00  3.821e+00
## factor(Policy_Sales_Channel)21              -7.839e-01  1.771e+00
## factor(Policy_Sales_Channel)22              -3.147e+00  1.224e+00
## factor(Policy_Sales_Channel)23              -7.062e-01  9.009e-01
## factor(Policy_Sales_Channel)24              -1.617e+00  7.779e-01
## factor(Policy_Sales_Channel)25              -1.977e+00  6.928e-01
## factor(Policy_Sales_Channel)26              -1.692e+00  6.090e-01
## factor(Policy_Sales_Channel)29              -2.543e+00  8.128e-01
## factor(Policy_Sales_Channel)30              -1.362e+00  7.530e-01
## factor(Policy_Sales_Channel)31              -1.491e+00  7.723e-01
## factor(Policy_Sales_Channel)32               8.726e+00  8.430e+00
## factor(Policy_Sales_Channel)35              -6.027e-01  2.474e+00
## factor(Policy_Sales_Channel)36               1.051e+00  1.421e+00
## factor(Policy_Sales_Channel)37              -1.911e+00  1.430e+00
## factor(Policy_Sales_Channel)38              -2.432e+01  5.006e+03
## factor(Policy_Sales_Channel)39               4.924e-01  8.430e+00
## factor(Policy_Sales_Channel)40               2.455e+00  5.181e+00
## factor(Policy_Sales_Channel)42              -1.092e+00  1.307e+00
## factor(Policy_Sales_Channel)44              -3.259e+00  1.361e+00
## factor(Policy_Sales_Channel)45              -4.524e+00  2.414e+00
## factor(Policy_Sales_Channel)46              -2.152e+01  7.374e+03
## factor(Policy_Sales_Channel)47              -2.745e+00  2.216e+00
## factor(Policy_Sales_Channel)48              -5.886e+00  6.947e+00
## factor(Policy_Sales_Channel)49               1.858e+01  1.840e+01
## factor(Policy_Sales_Channel)51               1.393e+02  4.976e+03
## factor(Policy_Sales_Channel)52              -2.027e+00  7.772e-01
```

```
## factor(Policy_Sales_Channel)53           -4.157e+00  2.754e+00
## factor(Policy_Sales_Channel)54           -1.347e+00  1.627e+00
## factor(Policy_Sales_Channel)55           -1.528e+00  7.245e-01
## factor(Policy_Sales_Channel)56           -1.475e+00  2.002e+00
## factor(Policy_Sales_Channel)57           -1.631e+01  1.845e+01
## factor(Policy_Sales_Channel)58           -1.411e+03  1.357e+04
## factor(Policy_Sales_Channel)59           -1.595e+00  1.363e+00
## factor(Policy_Sales_Channel)60           -1.729e+00  9.809e-01
## factor(Policy_Sales_Channel)61           -7.566e-01  9.784e-01
## factor(Policy_Sales_Channel)62            1.451e+02  9.556e+03
## factor(Policy_Sales_Channel)63            9.351e+00  1.110e+01
## factor(Policy_Sales_Channel)64           -3.147e+00  3.180e+00
## factor(Policy_Sales_Channel)65            4.661e+00  5.007e+00
## factor(Policy_Sales_Channel)66           -1.823e+01  9.802e+00
## factor(Policy_Sales_Channel)69           -2.557e+01  1.383e+01
## factor(Policy_Sales_Channel)71           -1.933e+01  1.179e+04
## factor(Policy_Sales_Channel)73            6.207e+00  1.197e+01
## factor(Policy_Sales_Channel)78           -1.520e+00  2.902e+00
## factor(Policy_Sales_Channel)79           -9.784e+00  3.450e+04
## factor(Policy_Sales_Channel)80           -5.228e+00  4.615e+00
## factor(Policy_Sales_Channel)81           -4.349e-01  6.541e+00
## factor(Policy_Sales_Channel)86            1.213e+00  3.840e+00
## factor(Policy_Sales_Channel)87           -4.243e+00  4.891e+00
## factor(Policy_Sales_Channel)88           -2.185e+00  5.238e+00
## factor(Policy_Sales_Channel)89           -4.715e+00  3.617e+00
## factor(Policy_Sales_Channel)90            1.483e+00  3.676e+00
## factor(Policy_Sales_Channel)91            6.401e-02  1.505e+00
## factor(Policy_Sales_Channel)92            1.753e+00  5.701e+00
## factor(Policy_Sales_Channel)93            2.214e-01  5.486e+00
## factor(Policy_Sales_Channel)94           -5.277e-01  2.303e+00
## factor(Policy_Sales_Channel)95           -1.954e+01  5.037e+03
## factor(Policy_Sales_Channel)96           -2.000e+01  4.692e+03
## factor(Policy_Sales_Channel)97            2.128e+00  7.700e+00
## factor(Policy_Sales_Channel)98            7.027e+00  1.126e+01
## factor(Policy_Sales_Channel)99           -2.389e+01  1.224e+04
## factor(Policy_Sales_Channel)100          -1.567e+01  1.434e+01
## factor(Policy_Sales_Channel)101           2.893e+00  1.379e+01
## factor(Policy_Sales_Channel)103          -5.069e-01  2.506e+00
## factor(Policy_Sales_Channel)104          -2.179e+01  1.561e+04
## factor(Policy_Sales_Channel)106          -3.588e-01  1.899e+00
## factor(Policy_Sales_Channel)107           3.822e+00  7.746e+00
## factor(Policy_Sales_Channel)108           8.605e+00  3.229e+01
## factor(Policy_Sales_Channel)109          -2.586e+00  1.464e+00
## factor(Policy_Sales_Channel)110           5.532e+02  5.759e+03
## factor(Policy_Sales_Channel)111           3.127e+00  3.168e+00
## factor(Policy_Sales_Channel)113          -3.103e-01  2.747e+00
## factor(Policy_Sales_Channel)114          -5.025e+00  3.475e+00
## factor(Policy_Sales_Channel)116          -2.149e+00  1.853e+00
## factor(Policy_Sales_Channel)117          -1.320e+01  5.382e+03
## factor(Policy_Sales_Channel)118          -1.725e+01  4.309e+03
## factor(Policy_Sales_Channel)119          -6.826e+00  3.340e+00
## factor(Policy_Sales_Channel)120          -1.053e+00  9.085e-01
## factor(Policy_Sales_Channel)121           9.560e-01  2.010e+00
## factor(Policy_Sales_Channel)122          -1.875e+00  6.175e-01
```

```
## factor(Policy_Sales_Channel)124                              -1.601e+00  6.096e-01
## factor(Policy_Sales_Channel)125                              -9.511e-01  7.722e-01
## factor(Policy_Sales_Channel)126                              -2.094e+01  2.515e+04
## factor(Policy_Sales_Channel)127                              -1.878e-02  1.979e+00
## factor(Policy_Sales_Channel)128                               2.541e+00  2.026e+00
## factor(Policy_Sales_Channel)129                              -2.516e+00  2.482e+00
## factor(Policy_Sales_Channel)130                               4.762e+02  2.740e+03
## factor(Policy_Sales_Channel)131                              -2.376e+00  1.335e+00
## factor(Policy_Sales_Channel)132                              -2.911e+00  2.476e+00
## factor(Policy_Sales_Channel)133                              -5.583e+00  2.761e+00
## factor(Policy_Sales_Channel)134                              -1.769e+01  5.229e+03
## factor(Policy_Sales_Channel)135                              -1.863e+00  1.574e+00
## factor(Policy_Sales_Channel)136                              -2.160e+00  9.753e-01
## factor(Policy_Sales_Channel)137                              -3.341e+01  1.701e+04
## factor(Policy_Sales_Channel)138                              -1.470e+00  1.866e+00
## factor(Policy_Sales_Channel)139                              -3.506e+00  1.379e+00
## factor(Policy_Sales_Channel)140                              -1.872e+00  1.929e+00
## factor(Policy_Sales_Channel)145                              -2.783e+00  1.250e+00
## factor(Policy_Sales_Channel)146                              -1.863e+01  3.166e+03
## factor(Policy_Sales_Channel)147                              -1.230e+00  9.822e-01
## factor(Policy_Sales_Channel)148                              -1.534e+00  1.866e+00
## factor(Policy_Sales_Channel)150                              -1.570e+00  8.594e-01
## factor(Policy_Sales_Channel)151                              -2.801e+00  7.953e-01
## factor(Policy_Sales_Channel)152                              -2.074e+00  6.050e-01
## factor(Policy_Sales_Channel)153                              -6.165e-01  1.157e+00
## factor(Policy_Sales_Channel)154                              -2.080e+00  6.184e-01
## factor(Policy_Sales_Channel)155                              -1.600e+00  6.528e-01
## factor(Policy_Sales_Channel)156                              -2.516e+00  6.130e-01
## factor(Policy_Sales_Channel)157                              -2.210e+00  6.165e-01
## factor(Policy_Sales_Channel)158                              -2.165e+00  6.820e-01
## factor(Policy_Sales_Channel)159                               1.561e+00  1.210e+01
## factor(Policy_Sales_Channel)160                              -2.940e+00  6.254e-01
## factor(Policy_Sales_Channel)163                              -2.159e+00  6.222e-01
## Age:Vehicle_Age1                                             -1.316e-01  4.233e-03
## Age:Vehicle_Age2                                             -1.286e-01  4.510e-03
## factor(Vehicle_Damage)1:factor(Previously_Insured)1          8.551e-01  1.642e-01
## Age:factor(Policy_Sales_Channel)3                            1.004e-01  1.722e-02
## Age:factor(Policy_Sales_Channel)4                            1.261e-01  1.973e-02
## Age:factor(Policy_Sales_Channel)7                            8.108e-02  1.660e-02
## Age:factor(Policy_Sales_Channel)8                            1.074e-01  1.688e-02
## Age:factor(Policy_Sales_Channel)9                            7.551e-02  3.266e-02
## Age:factor(Policy_Sales_Channel)10                           9.036e-02  2.203e-02
## Age:factor(Policy_Sales_Channel)11                           7.943e-02  1.795e-02
## Age:factor(Policy_Sales_Channel)12                           7.375e-02  1.776e-02
## Age:factor(Policy_Sales_Channel)13                           1.023e-01  1.580e-02
## Age:factor(Policy_Sales_Channel)14                           9.333e-02  1.950e-02
## Age:factor(Policy_Sales_Channel)15                           1.136e-01  1.803e-02
## Age:factor(Policy_Sales_Channel)16                           8.474e-02  2.040e-02
## Age:factor(Policy_Sales_Channel)17                           5.672e-02  7.488e-02
## Age:factor(Policy_Sales_Channel)18                           9.166e-02  4.444e-02
## Age:factor(Policy_Sales_Channel)19                           8.460e-02  3.260e-02
## Age:factor(Policy_Sales_Channel)20                           3.802e-02  8.182e-02
## Age:factor(Policy_Sales_Channel)21                           6.805e-02  3.782e-02
## Age:factor(Policy_Sales_Channel)22                           1.115e-01  2.541e-02
```

```
## Age:factor(Policy_Sales_Channel)23                    7.073e-02  2.030e-02
## Age:factor(Policy_Sales_Channel)24                    8.967e-02  1.750e-02
## Age:factor(Policy_Sales_Channel)25                    1.054e-01  1.583e-02
## Age:factor(Policy_Sales_Channel)26                    9.890e-02  1.463e-02
## Age:factor(Policy_Sales_Channel)29                    1.087e-01  1.836e-02
## Age:factor(Policy_Sales_Channel)30                    8.594e-02  1.677e-02
## Age:factor(Policy_Sales_Channel)31                    9.513e-02  1.790e-02
## Age:factor(Policy_Sales_Channel)32                   -1.332e-01  1.876e-01
## Age:factor(Policy_Sales_Channel)35                    6.768e-02  5.095e-02
## Age:factor(Policy_Sales_Channel)36                    3.921e-02  3.498e-02
## Age:factor(Policy_Sales_Channel)37                    8.900e-02  2.843e-02
## Age:factor(Policy_Sales_Channel)38                    2.609e-01  9.754e+01
## Age:factor(Policy_Sales_Channel)39                    2.961e-02  1.692e-01
## Age:factor(Policy_Sales_Channel)40                   -1.939e-02  1.302e-01
## Age:factor(Policy_Sales_Channel)42                    8.462e-02  2.722e-02
## Age:factor(Policy_Sales_Channel)44                    1.296e-01  2.786e-02
## Age:factor(Policy_Sales_Channel)45                    1.425e-01  5.034e-02
## Age:factor(Policy_Sales_Channel)46                    1.855e-01  1.492e+02
## Age:factor(Policy_Sales_Channel)47                    1.084e-01  4.592e-02
## Age:factor(Policy_Sales_Channel)48                    1.516e-01  1.258e-01
## Age:factor(Policy_Sales_Channel)49                   -3.265e-01  4.011e-01
## Age:factor(Policy_Sales_Channel)51                   -3.504e+00  1.276e+02
## Age:factor(Policy_Sales_Channel)52                    9.349e-02  1.750e-02
## Age:factor(Policy_Sales_Channel)53                    1.448e-01  5.565e-02
## Age:factor(Policy_Sales_Channel)54                    7.952e-02  3.390e-02
## Age:factor(Policy_Sales_Channel)55                    8.719e-02  1.656e-02
## Age:factor(Policy_Sales_Channel)56                    8.966e-02  4.142e-02
## Age:factor(Policy_Sales_Channel)57                    4.368e-01  4.338e-01
## Age:factor(Policy_Sales_Channel)58                    2.131e+01  2.043e+02
## Age:factor(Policy_Sales_Channel)59                    9.219e-02  2.766e-02
## Age:factor(Policy_Sales_Channel)60                    8.668e-02  2.167e-02
## Age:factor(Policy_Sales_Channel)61                    6.256e-02  2.190e-02
## Age:factor(Policy_Sales_Channel)62                   -3.012e+00  1.975e+02
## Age:factor(Policy_Sales_Channel)63                   -1.126e-01  2.153e-01
## Age:factor(Policy_Sales_Channel)64                    1.093e-01  6.602e-02
## Age:factor(Policy_Sales_Channel)65                   -4.936e-02  1.077e-01
## Age:factor(Policy_Sales_Channel)66                    3.844e-01  1.724e-01
## Age:factor(Policy_Sales_Channel)69                    5.026e-01  2.123e-01
## Age:factor(Policy_Sales_Channel)71                    1.410e-01  2.695e+02
## Age:factor(Policy_Sales_Channel)73                   -1.191e-01  2.943e-01
## Age:factor(Policy_Sales_Channel)78                    9.510e-02  5.700e-02
## Age:factor(Policy_Sales_Channel)79                   -8.848e-02  7.572e+02
## Age:factor(Policy_Sales_Channel)80                    1.759e-01  8.891e-02
## Age:factor(Policy_Sales_Channel)81                    9.530e-02  1.201e-01
## Age:factor(Policy_Sales_Channel)86                    3.295e-02  8.595e-02
## Age:factor(Policy_Sales_Channel)87                    1.602e-01  1.066e-01
## Age:factor(Policy_Sales_Channel)88                    7.292e-02  1.100e-01
## Age:factor(Policy_Sales_Channel)89                    1.484e-01  6.182e-02
## Age:factor(Policy_Sales_Channel)90                    4.177e-02  7.782e-02
## Age:factor(Policy_Sales_Channel)91                    6.224e-02  3.216e-02
## Age:factor(Policy_Sales_Channel)92                    2.412e-02  1.248e-01
## Age:factor(Policy_Sales_Channel)93                    4.186e-02  1.155e-01
## Age:factor(Policy_Sales_Channel)94                    7.792e-02  4.548e-02
## Age:factor(Policy_Sales_Channel)95                    1.461e-01  8.507e+01
```

```
## Age:factor(Policy_Sales_Channel)96              1.557e-01   9.023e+01
## Age:factor(Policy_Sales_Channel)97              2.275e-02   1.500e-01
## Age:factor(Policy_Sales_Channel)98             -1.079e-01   2.512e-01
## Age:factor(Policy_Sales_Channel)99              2.405e-01   2.299e+02
## Age:factor(Policy_Sales_Channel)100             3.562e-01   2.549e-01
## Age:factor(Policy_Sales_Channel)101             7.427e-03   2.965e-01
## Age:factor(Policy_Sales_Channel)103             7.077e-02   5.203e-02
## Age:factor(Policy_Sales_Channel)104             1.954e-01   3.285e+02
## Age:factor(Policy_Sales_Channel)106             7.701e-02   3.948e-02
## Age:factor(Policy_Sales_Channel)107            -1.000e-01   2.730e-01
## Age:factor(Policy_Sales_Channel)108            -1.833e-01   8.469e-01
## Age:factor(Policy_Sales_Channel)109             1.025e-01   3.210e-02
## Age:factor(Policy_Sales_Channel)110            -1.422e+01   1.491e+02
## Age:factor(Policy_Sales_Channel)111            -2.515e-02   7.526e-02
## Age:factor(Policy_Sales_Channel)113             5.751e-02   6.029e-02
## Age:factor(Policy_Sales_Channel)114             1.513e-01   6.691e-02
## Age:factor(Policy_Sales_Channel)116             9.761e-02   3.495e-02
## Age:factor(Policy_Sales_Channel)117             1.208e-01   1.057e+02
## Age:factor(Policy_Sales_Channel)118             1.020e-01   7.224e+01
## Age:factor(Policy_Sales_Channel)119             1.765e-01   5.389e-02
## Age:factor(Policy_Sales_Channel)120             7.762e-02   1.989e-02
## Age:factor(Policy_Sales_Channel)121             2.759e-02   6.235e-02
## Age:factor(Policy_Sales_Channel)122             9.676e-02   1.477e-02
## Age:factor(Policy_Sales_Channel)124             9.217e-02   1.465e-02
## Age:factor(Policy_Sales_Channel)125             7.128e-02   1.770e-02
## Age:factor(Policy_Sales_Channel)126             1.848e-01   4.882e+02
## Age:factor(Policy_Sales_Channel)127             4.374e-02   4.328e-02
## Age:factor(Policy_Sales_Channel)128            -7.802e-03   4.693e-02
## Age:factor(Policy_Sales_Channel)129             9.019e-02   5.405e-02
## Age:factor(Policy_Sales_Channel)130            -1.605e+01   9.303e+01
## Age:factor(Policy_Sales_Channel)131             9.611e-02   2.900e-02
## Age:factor(Policy_Sales_Channel)132             1.034e-01   4.801e-02
## Age:factor(Policy_Sales_Channel)133             1.531e-01   4.881e-02
## Age:factor(Policy_Sales_Channel)134             1.158e-01   8.334e+01
## Age:factor(Policy_Sales_Channel)135             8.542e-02   3.317e-02
## Age:factor(Policy_Sales_Channel)136             1.082e-01   2.187e-02
## Age:factor(Policy_Sales_Channel)137             4.520e-01   3.472e+02
## Age:factor(Policy_Sales_Channel)138             8.012e-02   4.122e-02
## Age:factor(Policy_Sales_Channel)139             1.171e-01   2.788e-02
## Age:factor(Policy_Sales_Channel)140             7.997e-02   4.240e-02
## Age:factor(Policy_Sales_Channel)145             1.176e-01   2.506e-02
## Age:factor(Policy_Sales_Channel)146             1.329e-01   5.806e+01
## Age:factor(Policy_Sales_Channel)147             8.417e-02   2.156e-02
## Age:factor(Policy_Sales_Channel)148             8.890e-02   3.738e-02
## Age:factor(Policy_Sales_Channel)150             9.380e-02   1.979e-02
## Age:factor(Policy_Sales_Channel)151             1.008e-01   2.472e-02
## Age:factor(Policy_Sales_Channel)152             7.842e-02   1.458e-02
## Age:factor(Policy_Sales_Channel)153             3.728e-02   3.995e-02
## Age:factor(Policy_Sales_Channel)154             1.040e-01   1.487e-02
## Age:factor(Policy_Sales_Channel)155             1.018e-01   1.559e-02
## Age:factor(Policy_Sales_Channel)156             1.106e-01   1.474e-02
## Age:factor(Policy_Sales_Channel)157             1.087e-01   1.480e-02
## Age:factor(Policy_Sales_Channel)158             1.086e-01   1.611e-02
## Age:factor(Policy_Sales_Channel)159            -1.154e-01   5.730e-01
```

```
## Age:factor(Policy_Sales_Channel)160         8.542e-02  1.598e-02
## Age:factor(Policy_Sales_Channel)163         1.136e-01  1.497e-02
##                                              z value Pr(>|z|)
## (Intercept)                                   -9.189  < 2e-16 ***
## Gender1                                        5.696 1.22e-08 ***
## Age                                            0.370 0.711443
## Vehicle_Age1                                  32.315  < 2e-16 ***
## Vehicle_Age2                                  27.053  < 2e-16 ***
## factor(Driving_License)1                       6.874 6.23e-12 ***
## factor(Region_Code)1                           1.716 0.086210 .
## factor(Region_Code)2                           5.391 7.01e-08 ***
## factor(Region_Code)3                          10.298  < 2e-16 ***
## factor(Region_Code)4                           7.991 1.34e-15 ***
## factor(Region_Code)5                           6.097 1.08e-09 ***
## factor(Region_Code)6                           9.231  < 2e-16 ***
## factor(Region_Code)7                           6.973 3.09e-12 ***
## factor(Region_Code)8                           6.828 8.59e-12 ***
## factor(Region_Code)9                           3.772 0.000162 ***
## factor(Region_Code)10                          6.413 1.43e-10 ***
## factor(Region_Code)11                         12.191  < 2e-16 ***
## factor(Region_Code)12                          7.014 2.32e-12 ***
## factor(Region_Code)13                          6.813 9.56e-12 ***
## factor(Region_Code)14                          7.991 1.34e-15 ***
## factor(Region_Code)15                          6.304 2.90e-10 ***
## factor(Region_Code)16                          4.731 2.24e-06 ***
## factor(Region_Code)17                          4.032 5.54e-05 ***
## factor(Region_Code)18                         10.634  < 2e-16 ***
## factor(Region_Code)19                          6.529 6.60e-11 ***
## factor(Region_Code)20                          3.050 0.002291 **
## factor(Region_Code)21                          7.935 2.11e-15 ***
## factor(Region_Code)22                          2.386 0.017012 *
## factor(Region_Code)23                          8.165 3.22e-16 ***
## factor(Region_Code)24                          7.386 1.51e-13 ***
## factor(Region_Code)25                          1.820 0.068815 .
## factor(Region_Code)26                          2.667 0.007653 **
## factor(Region_Code)27                          5.279 1.30e-07 ***
## factor(Region_Code)28                          9.802  < 2e-16 ***
## factor(Region_Code)29                         11.821  < 2e-16 ***
## factor(Region_Code)30                         10.000  < 2e-16 ***
## factor(Region_Code)31                          3.259 0.001120 **
## factor(Region_Code)32                          7.388 1.49e-13 ***
## factor(Region_Code)33                          7.553 4.26e-14 ***
## factor(Region_Code)34                          3.229 0.001240 **
## factor(Region_Code)35                         10.998  < 2e-16 ***
## factor(Region_Code)36                          7.042 1.90e-12 ***
## factor(Region_Code)37                          6.452 1.11e-10 ***
## factor(Region_Code)38                          8.881  < 2e-16 ***
## factor(Region_Code)39                          6.348 2.18e-10 ***
## factor(Region_Code)40                          4.975 6.52e-07 ***
## factor(Region_Code)41                         11.501  < 2e-16 ***
## factor(Region_Code)42                          1.780 0.075003 .
## factor(Region_Code)43                          3.995 6.47e-05 ***
## factor(Region_Code)44                          0.530 0.596335
## factor(Region_Code)45                          8.140 3.96e-16 ***
```

```
## factor(Region_Code)46                               8.399  < 2e-16 ***
## factor(Region_Code)47                               5.572 2.52e-08 ***
## factor(Region_Code)48                               2.225 0.026064 *
## factor(Region_Code)49                               3.552 0.000383 ***
## factor(Region_Code)50                               3.540 0.000401 ***
## factor(Region_Code)51                               3.336 0.000850 ***
## factor(Region_Code)52                               3.108 0.001882 **
## factor(Vehicle_Damage)1                            55.045  < 2e-16 ***
## factor(Previously_Insured)1                       -35.320  < 2e-16 ***
## Annual_Premium                                      4.027 5.64e-05 ***
## factor(Policy_Sales_Channel)3                      -1.811 0.070131 .
## factor(Policy_Sales_Channel)4                      -3.428 0.000608 ***
## factor(Policy_Sales_Channel)7                      -1.319 0.187051
## factor(Policy_Sales_Channel)8                      -3.351 0.000805 ***
## factor(Policy_Sales_Channel)9                      -0.478 0.632301
## factor(Policy_Sales_Channel)10                     -1.502 0.133028
## factor(Policy_Sales_Channel)11                     -1.788 0.073731 .
## factor(Policy_Sales_Channel)12                     -1.078 0.280991
## factor(Policy_Sales_Channel)13                     -3.358 0.000786 ***
## factor(Policy_Sales_Channel)14                     -1.996 0.045954 *
## factor(Policy_Sales_Channel)15                     -3.150 0.001631 **
## factor(Policy_Sales_Channel)16                     -1.565 0.117572
## factor(Policy_Sales_Channel)17                      0.208 0.835290
## factor(Policy_Sales_Channel)18                     -1.102 0.270548
## factor(Policy_Sales_Channel)19                     -1.058 0.290185
## factor(Policy_Sales_Channel)20                      0.271 0.786388
## factor(Policy_Sales_Channel)21                     -0.443 0.658094
## factor(Policy_Sales_Channel)22                     -2.572 0.010120 *
## factor(Policy_Sales_Channel)23                     -0.784 0.433112
## factor(Policy_Sales_Channel)24                     -2.079 0.037659 *
## factor(Policy_Sales_Channel)25                     -2.854 0.004320 **
## factor(Policy_Sales_Channel)26                     -2.778 0.005477 **
## factor(Policy_Sales_Channel)29                     -3.128 0.001757 **
## factor(Policy_Sales_Channel)30                     -1.809 0.070422 .
## factor(Policy_Sales_Channel)31                     -1.930 0.053560 .
## factor(Policy_Sales_Channel)32                      1.035 0.300597
## factor(Policy_Sales_Channel)35                     -0.244 0.807498
## factor(Policy_Sales_Channel)36                      0.740 0.459465
## factor(Policy_Sales_Channel)37                     -1.336 0.181455
## factor(Policy_Sales_Channel)38                     -0.005 0.996124
## factor(Policy_Sales_Channel)39                      0.058 0.953425
## factor(Policy_Sales_Channel)40                      0.474 0.635553
## factor(Policy_Sales_Channel)42                     -0.835 0.403589
## factor(Policy_Sales_Channel)44                     -2.395 0.016635 *
## factor(Policy_Sales_Channel)45                     -1.874 0.060936 .
## factor(Policy_Sales_Channel)46                     -0.003 0.997672
## factor(Policy_Sales_Channel)47                     -1.239 0.215471
## factor(Policy_Sales_Channel)48                     -0.847 0.396814
## factor(Policy_Sales_Channel)49                      1.010 0.312438
## factor(Policy_Sales_Channel)51                      0.028 0.977667
## factor(Policy_Sales_Channel)52                     -2.608 0.009099 **
## factor(Policy_Sales_Channel)53                     -1.510 0.131162
## factor(Policy_Sales_Channel)54                     -0.828 0.407581
## factor(Policy_Sales_Channel)55                     -2.109 0.034906 *
```

```
## factor(Policy_Sales_Channel)56                      -0.737 0.461381
## factor(Policy_Sales_Channel)57                      -0.884 0.376732
## factor(Policy_Sales_Channel)58                      -0.104 0.917207
## factor(Policy_Sales_Channel)59                      -1.171 0.241791
## factor(Policy_Sales_Channel)60                      -1.763 0.077882 .
## factor(Policy_Sales_Channel)61                      -0.773 0.439332
## factor(Policy_Sales_Channel)62                       0.015 0.987887
## factor(Policy_Sales_Channel)63                       0.843 0.399374
## factor(Policy_Sales_Channel)64                      -0.990 0.322418
## factor(Policy_Sales_Channel)65                       0.931 0.351900
## factor(Policy_Sales_Channel)66                      -1.860 0.062870 .
## factor(Policy_Sales_Channel)69                      -1.849 0.064486 .
## factor(Policy_Sales_Channel)71                      -0.002 0.998691
## factor(Policy_Sales_Channel)73                       0.518 0.604222
## factor(Policy_Sales_Channel)78                      -0.524 0.600318
## factor(Policy_Sales_Channel)79                       0.000 0.999774
## factor(Policy_Sales_Channel)80                      -1.133 0.257232
## factor(Policy_Sales_Channel)81                      -0.066 0.946984
## factor(Policy_Sales_Channel)86                       0.316 0.752141
## factor(Policy_Sales_Channel)87                      -0.868 0.385665
## factor(Policy_Sales_Channel)88                      -0.417 0.676600
## factor(Policy_Sales_Channel)89                      -1.304 0.192391
## factor(Policy_Sales_Channel)90                       0.403 0.686586
## factor(Policy_Sales_Channel)91                       0.043 0.966070
## factor(Policy_Sales_Channel)92                       0.307 0.758484
## factor(Policy_Sales_Channel)93                       0.040 0.967806
## factor(Policy_Sales_Channel)94                      -0.229 0.818807
## factor(Policy_Sales_Channel)95                      -0.004 0.996904
## factor(Policy_Sales_Channel)96                      -0.004 0.996598
## factor(Policy_Sales_Channel)97                       0.276 0.782236
## factor(Policy_Sales_Channel)98                       0.624 0.532559
## factor(Policy_Sales_Channel)99                      -0.002 0.998443
## factor(Policy_Sales_Channel)100                     -1.093 0.274273
## factor(Policy_Sales_Channel)101                      0.210 0.833910
## factor(Policy_Sales_Channel)103                     -0.202 0.839739
## factor(Policy_Sales_Channel)104                     -0.001 0.998886
## factor(Policy_Sales_Channel)106                     -0.189 0.850113
## factor(Policy_Sales_Channel)107                      0.493 0.621709
## factor(Policy_Sales_Channel)108                      0.266 0.789873
## factor(Policy_Sales_Channel)109                     -1.767 0.077303 .
## factor(Policy_Sales_Channel)110                      0.096 0.923470
## factor(Policy_Sales_Channel)111                      0.987 0.323726
## factor(Policy_Sales_Channel)113                     -0.113 0.910059
## factor(Policy_Sales_Channel)114                     -1.446 0.148134
## factor(Policy_Sales_Channel)116                     -1.160 0.246054
## factor(Policy_Sales_Channel)117                     -0.002 0.998043
## factor(Policy_Sales_Channel)118                     -0.004 0.996806
## factor(Policy_Sales_Channel)119                     -2.043 0.041018 *
## factor(Policy_Sales_Channel)120                     -1.160 0.246187
## factor(Policy_Sales_Channel)121                      0.476 0.634405
## factor(Policy_Sales_Channel)122                     -3.037 0.002393 **
## factor(Policy_Sales_Channel)124                     -2.626 0.008636 **
## factor(Policy_Sales_Channel)125                     -1.232 0.218069
## factor(Policy_Sales_Channel)126                     -0.001 0.999336
```

```
## factor(Policy_Sales_Channel)127                            -0.009 0.992428
## factor(Policy_Sales_Channel)128                             1.254 0.209708
## factor(Policy_Sales_Channel)129                            -1.014 0.310747
## factor(Policy_Sales_Channel)130                             0.174 0.862020
## factor(Policy_Sales_Channel)131                            -1.781 0.074993 .
## factor(Policy_Sales_Channel)132                            -1.176 0.239772
## factor(Policy_Sales_Channel)133                            -2.022 0.043142 *
## factor(Policy_Sales_Channel)134                            -0.003 0.997301
## factor(Policy_Sales_Channel)135                            -1.184 0.236502
## factor(Policy_Sales_Channel)136                            -2.215 0.026769 *
## factor(Policy_Sales_Channel)137                            -0.002 0.998433
## factor(Policy_Sales_Channel)138                            -0.787 0.431011
## factor(Policy_Sales_Channel)139                            -2.543 0.010997 *
## factor(Policy_Sales_Channel)140                            -0.970 0.331892
## factor(Policy_Sales_Channel)145                            -2.227 0.025963 *
## factor(Policy_Sales_Channel)146                            -0.006 0.995303
## factor(Policy_Sales_Channel)147                            -1.252 0.210431
## factor(Policy_Sales_Channel)148                            -0.822 0.410859
## factor(Policy_Sales_Channel)150                            -1.826 0.067815 .
## factor(Policy_Sales_Channel)151                            -3.522 0.000428 ***
## factor(Policy_Sales_Channel)152                            -3.428 0.000607 ***
## factor(Policy_Sales_Channel)153                            -0.533 0.594049
## factor(Policy_Sales_Channel)154                            -3.364 0.000769 ***
## factor(Policy_Sales_Channel)155                            -2.450 0.014277 *
## factor(Policy_Sales_Channel)156                            -4.104 4.06e-05 ***
## factor(Policy_Sales_Channel)157                            -3.586 0.000336 ***
## factor(Policy_Sales_Channel)158                            -3.175 0.001497 **
## factor(Policy_Sales_Channel)159                             0.129 0.897321
## factor(Policy_Sales_Channel)160                            -4.700 2.60e-06 ***
## factor(Policy_Sales_Channel)163                            -3.471 0.000519 ***
## Age:Vehicle_Age1                                          -31.092  < 2e-16 ***
## Age:Vehicle_Age2                                          -28.511  < 2e-16 ***
## factor(Vehicle_Damage)1:factor(Previously_Insured)1         5.208 1.91e-07 ***
## Age:factor(Policy_Sales_Channel)3                           5.832 5.47e-09 ***
## Age:factor(Policy_Sales_Channel)4                           6.388 1.68e-10 ***
## Age:factor(Policy_Sales_Channel)7                           4.883 1.04e-06 ***
## Age:factor(Policy_Sales_Channel)8                           6.364 1.97e-10 ***
## Age:factor(Policy_Sales_Channel)9                           2.312 0.020762 *
## Age:factor(Policy_Sales_Channel)10                          4.102 4.09e-05 ***
## Age:factor(Policy_Sales_Channel)11                          4.425 9.65e-06 ***
## Age:factor(Policy_Sales_Channel)12                          4.153 3.28e-05 ***
## Age:factor(Policy_Sales_Channel)13                          6.473 9.63e-11 ***
## Age:factor(Policy_Sales_Channel)14                          4.786 1.70e-06 ***
## Age:factor(Policy_Sales_Channel)15                          6.302 2.95e-10 ***
## Age:factor(Policy_Sales_Channel)16                          4.155 3.25e-05 ***
## Age:factor(Policy_Sales_Channel)17                          0.758 0.448729
## Age:factor(Policy_Sales_Channel)18                          2.063 0.039153 *
## Age:factor(Policy_Sales_Channel)19                          2.595 0.009468 **
## Age:factor(Policy_Sales_Channel)20                          0.465 0.642185
## Age:factor(Policy_Sales_Channel)21                          1.799 0.071995 .
## Age:factor(Policy_Sales_Channel)22                          4.387 1.15e-05 ***
## Age:factor(Policy_Sales_Channel)23                          3.485 0.000493 ***
## Age:factor(Policy_Sales_Channel)24                          5.125 2.97e-07 ***
## Age:factor(Policy_Sales_Channel)25                          6.658 2.78e-11 ***
```

```
## Age:factor(Policy_Sales_Channel)26                        6.759 1.39e-11 ***
## Age:factor(Policy_Sales_Channel)29                        5.918 3.26e-09 ***
## Age:factor(Policy_Sales_Channel)30                        5.126 2.96e-07 ***
## Age:factor(Policy_Sales_Channel)31                        5.314 1.08e-07 ***
## Age:factor(Policy_Sales_Channel)32                       -0.710 0.477587
## Age:factor(Policy_Sales_Channel)35                        1.328 0.184078
## Age:factor(Policy_Sales_Channel)36                        1.121 0.262310
## Age:factor(Policy_Sales_Channel)37                        3.130 0.001746 **
## Age:factor(Policy_Sales_Channel)38                        0.003 0.997866
## Age:factor(Policy_Sales_Channel)39                        0.175 0.861126
## Age:factor(Policy_Sales_Channel)40                       -0.149 0.881599
## Age:factor(Policy_Sales_Channel)42                        3.109 0.001876 **
## Age:factor(Policy_Sales_Channel)44                        4.654 3.26e-06 ***
## Age:factor(Policy_Sales_Channel)45                        2.831 0.004638 **
## Age:factor(Policy_Sales_Channel)46                        0.001 0.999007
## Age:factor(Policy_Sales_Channel)47                        2.360 0.018263 *
## Age:factor(Policy_Sales_Channel)48                        1.205 0.228117
## Age:factor(Policy_Sales_Channel)49                       -0.814 0.415586
## Age:factor(Policy_Sales_Channel)51                       -0.027 0.978089
## Age:factor(Policy_Sales_Channel)52                        5.343 9.13e-08 ***
## Age:factor(Policy_Sales_Channel)53                        2.601 0.009286 **
## Age:factor(Policy_Sales_Channel)54                        2.345 0.019013 *
## Age:factor(Policy_Sales_Channel)55                        5.265 1.40e-07 ***
## Age:factor(Policy_Sales_Channel)56                        2.164 0.030431 *
## Age:factor(Policy_Sales_Channel)57                        1.007 0.313894
## Age:factor(Policy_Sales_Channel)58                        0.104 0.916919
## Age:factor(Policy_Sales_Channel)59                        3.332 0.000861 ***
## Age:factor(Policy_Sales_Channel)60                        4.001 6.31e-05 ***
## Age:factor(Policy_Sales_Channel)61                        2.856 0.004285 **
## Age:factor(Policy_Sales_Channel)62                       -0.015 0.987833
## Age:factor(Policy_Sales_Channel)63                       -0.523 0.601113
## Age:factor(Policy_Sales_Channel)64                        1.655 0.097916 .
## Age:factor(Policy_Sales_Channel)65                       -0.458 0.646877
## Age:factor(Policy_Sales_Channel)66                        2.230 0.025747 *
## Age:factor(Policy_Sales_Channel)69                        2.367 0.017928 *
## Age:factor(Policy_Sales_Channel)71                        0.001 0.999583
## Age:factor(Policy_Sales_Channel)73                       -0.405 0.685777
## Age:factor(Policy_Sales_Channel)78                        1.668 0.095239 .
## Age:factor(Policy_Sales_Channel)79                        0.000 0.999907
## Age:factor(Policy_Sales_Channel)80                        1.979 0.047850 *
## Age:factor(Policy_Sales_Channel)81                        0.793 0.427519
## Age:factor(Policy_Sales_Channel)86                        0.383 0.701430
## Age:factor(Policy_Sales_Channel)87                        1.502 0.132985
## Age:factor(Policy_Sales_Channel)88                        0.663 0.507362
## Age:factor(Policy_Sales_Channel)89                        2.400 0.016373 *
## Age:factor(Policy_Sales_Channel)90                        0.537 0.591461
## Age:factor(Policy_Sales_Channel)91                        1.935 0.052961 .
## Age:factor(Policy_Sales_Channel)92                        0.193 0.846692
## Age:factor(Policy_Sales_Channel)93                        0.362 0.717129
## Age:factor(Policy_Sales_Channel)94                        1.713 0.086680 .
## Age:factor(Policy_Sales_Channel)95                        0.002 0.998630
## Age:factor(Policy_Sales_Channel)96                        0.002 0.998623
## Age:factor(Policy_Sales_Channel)97                        0.152 0.879433
## Age:factor(Policy_Sales_Channel)98                       -0.429 0.667634
```

```
## Age:factor(Policy_Sales_Channel)99                  0.001 0.999165
## Age:factor(Policy_Sales_Channel)100                 1.397 0.162419
## Age:factor(Policy_Sales_Channel)101                 0.025 0.980020
## Age:factor(Policy_Sales_Channel)103                 1.360 0.173787
## Age:factor(Policy_Sales_Channel)104                 0.001 0.999525
## Age:factor(Policy_Sales_Channel)106                 1.951 0.051083 .
## Age:factor(Policy_Sales_Channel)107                -0.366 0.714136
## Age:factor(Policy_Sales_Channel)108                -0.216 0.828646
## Age:factor(Policy_Sales_Channel)109                 3.194 0.001403 **
## Age:factor(Policy_Sales_Channel)110                -0.095 0.924025
## Age:factor(Policy_Sales_Channel)111                -0.334 0.738245
## Age:factor(Policy_Sales_Channel)113                 0.954 0.340122
## Age:factor(Policy_Sales_Channel)114                 2.262 0.023723 *
## Age:factor(Policy_Sales_Channel)116                 2.793 0.005229 **
## Age:factor(Policy_Sales_Channel)117                 0.001 0.999088
## Age:factor(Policy_Sales_Channel)118                 0.001 0.998873
## Age:factor(Policy_Sales_Channel)119                 3.275 0.001058 **
## Age:factor(Policy_Sales_Channel)120                 3.901 9.56e-05 ***
## Age:factor(Policy_Sales_Channel)121                 0.443 0.658095
## Age:factor(Policy_Sales_Channel)122                 6.550 5.77e-11 ***
## Age:factor(Policy_Sales_Channel)124                 6.291 3.16e-10 ***
## Age:factor(Policy_Sales_Channel)125                 4.027 5.66e-05 ***
## Age:factor(Policy_Sales_Channel)126                 0.000 0.999698
## Age:factor(Policy_Sales_Channel)127                 1.011 0.312165
## Age:factor(Policy_Sales_Channel)128                -0.166 0.867956
## Age:factor(Policy_Sales_Channel)129                 1.669 0.095193 .
## Age:factor(Policy_Sales_Channel)130                -0.172 0.863068
## Age:factor(Policy_Sales_Channel)131                 3.314 0.000919 ***
## Age:factor(Policy_Sales_Channel)132                 2.153 0.031323 *
## Age:factor(Policy_Sales_Channel)133                 3.137 0.001706 **
## Age:factor(Policy_Sales_Channel)134                 0.001 0.998891
## Age:factor(Policy_Sales_Channel)135                 2.576 0.010008 *
## Age:factor(Policy_Sales_Channel)136                 4.948 7.51e-07 ***
## Age:factor(Policy_Sales_Channel)137                 0.001 0.998961
## Age:factor(Policy_Sales_Channel)138                 1.944 0.051943 .
## Age:factor(Policy_Sales_Channel)139                 4.198 2.69e-05 ***
## Age:factor(Policy_Sales_Channel)140                 1.886 0.059272 .
## Age:factor(Policy_Sales_Channel)145                 4.691 2.72e-06 ***
## Age:factor(Policy_Sales_Channel)146                 0.002 0.998174
## Age:factor(Policy_Sales_Channel)147                 3.904 9.46e-05 ***
## Age:factor(Policy_Sales_Channel)148                 2.378 0.017397 *
## Age:factor(Policy_Sales_Channel)150                 4.739 2.14e-06 ***
## Age:factor(Policy_Sales_Channel)151                 4.077 4.56e-05 ***
## Age:factor(Policy_Sales_Channel)152                 5.380 7.44e-08 ***
## Age:factor(Policy_Sales_Channel)153                 0.933 0.350807
## Age:factor(Policy_Sales_Channel)154                 6.995 2.64e-12 ***
## Age:factor(Policy_Sales_Channel)155                 6.530 6.58e-11 ***
## Age:factor(Policy_Sales_Channel)156                 7.500 6.38e-14 ***
## Age:factor(Policy_Sales_Channel)157                 7.346 2.05e-13 ***
## Age:factor(Policy_Sales_Channel)158                 6.741 1.57e-11 ***
## Age:factor(Policy_Sales_Channel)159                -0.201 0.840416
## Age:factor(Policy_Sales_Channel)160                 5.346 9.02e-08 ***
## Age:factor(Policy_Sales_Channel)163                 7.589 3.23e-14 ***
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 283505  on 381040  degrees of freedom
## Residual deviance: 202880  on 380721  degrees of freedom
## AIC: 203520
##
## Number of Fisher Scoring iterations: 16
```

vif(glm1)

```
##                                        Gender1
##                                   1.223525e+01
##                                            Age
##                                   1.799034e+04
##                                    Vehicle_Age1
##                                   1.488024e+03
##                                    Vehicle_Age2
##                                   3.544852e+02
##                        factor(Driving_License)1
##                                   2.181143e+01
##                            factor(Region_Code)1
##                                   1.832870e+01
##                            factor(Region_Code)2
##                                   4.571786e+01
##                            factor(Region_Code)3
##                                   7.395276e+01
##                            factor(Region_Code)4
##                                   2.169960e+01
##                            factor(Region_Code)5
##                                   2.045655e+01
##                            factor(Region_Code)6
##                                   6.305389e+01
##                            factor(Region_Code)7
##                                   3.297066e+01
##                            factor(Region_Code)8
##                                   2.289465e+02
##                            factor(Region_Code)9
##                                   3.683441e+01
##                           factor(Region_Code)10
##                                   5.186870e+01
##                           factor(Region_Code)11
##                                   7.630662e+01
##                           factor(Region_Code)12
##                                   3.617332e+01
##                           factor(Region_Code)13
##                                   4.246071e+01
##                           factor(Region_Code)14
##                                   4.755154e+01
##                           factor(Region_Code)15
##                                   1.076591e+02
##                           factor(Region_Code)16
##                                   3.270265e+01
```

```
##                              factor(Region_Code)17
##                                        3.624598e+01
##                              factor(Region_Code)18
##                                        4.690926e+01
##                              factor(Region_Code)19
##                                        1.921871e+01
##                              factor(Region_Code)20
##                                        2.427190e+01
##                              factor(Region_Code)21
##                                        4.883383e+01
##                              factor(Region_Code)22
##                                        2.852939e+01
##                              factor(Region_Code)23
##                                        2.318138e+01
##                              factor(Region_Code)24
##                                        2.704507e+01
##                              factor(Region_Code)25
##                                        4.520721e+01
##                              factor(Region_Code)26
##                                        3.601637e+01
##                              factor(Region_Code)27
##                                        3.629172e+01
##                              factor(Region_Code)28
##                                        5.422808e+02
##                              factor(Region_Code)29
##                                        8.705900e+01
##                              factor(Region_Code)30
##                                        1.011485e+02
##                              factor(Region_Code)31
##                                        2.714974e+01
##                              factor(Region_Code)32
##                                        3.470396e+01
##                              factor(Region_Code)33
##                                        6.603005e+01
##                              factor(Region_Code)34
##                                        2.779195e+01
##                              factor(Region_Code)35
##                                        6.000591e+01
##                              factor(Region_Code)36
##                                        7.603703e+01
##                              factor(Region_Code)37
##                                        5.399351e+01
##                              factor(Region_Code)38
##                                        2.168764e+01
##                              factor(Region_Code)39
##                                        4.281054e+01
##                              factor(Region_Code)40
##                                        2.008201e+01
##                              factor(Region_Code)41
##                                        1.338740e+02
##                              factor(Region_Code)42
##                                        2.065513e+01
##                              factor(Region_Code)43
##                                        3.198550e+01
```

```
##                          factor(Region_Code)44
##                                   3.547163e+01
##                          factor(Region_Code)45
##                                   5.095253e+01
##                          factor(Region_Code)46
##                                   1.435426e+02
##                          factor(Region_Code)47
##                                   6.586579e+01
##                          factor(Region_Code)48
##                                   4.535701e+01
##                          factor(Region_Code)49
##                                   2.918748e+01
##                          factor(Region_Code)50
##                                   9.167681e+01
##                          factor(Region_Code)51
##                                   1.054172e+01
##                          factor(Region_Code)52
##                                   1.301831e+01
##                        factor(Vehicle_Damage)1
##                                   1.164716e+02
##                   factor(Previously_Insured)1
##                                   1.432258e+03
##                                 Annual_Premium
##                                   1.330849e+01
##                 factor(Policy_Sales_Channel)3
##                                   3.371228e+02
##                 factor(Policy_Sales_Channel)4
##                                   4.061115e+02
##                 factor(Policy_Sales_Channel)7
##                                   8.462730e+02
##                 factor(Policy_Sales_Channel)8
##                                   8.527863e+02
##                 factor(Policy_Sales_Channel)9
##                                   4.438089e+02
##                factor(Policy_Sales_Channel)10
##                                   2.948411e+02
##                factor(Policy_Sales_Channel)11
##                                   7.677039e+02
##                factor(Policy_Sales_Channel)12
##                                   4.830212e+02
##                factor(Policy_Sales_Channel)13
##                                   8.700898e+02
##                factor(Policy_Sales_Channel)14
##                                   4.856208e+02
##                factor(Policy_Sales_Channel)15
##                                   6.204316e+02
##                factor(Policy_Sales_Channel)16
##                                   4.573404e+02
##                factor(Policy_Sales_Channel)17
##                                   2.228594e+02
##                factor(Policy_Sales_Channel)18
##                                   7.879215e+02
##                factor(Policy_Sales_Channel)19
##                                   5.008917e+02
```

```
##                           factor(Policy_Sales_Channel)20
##                                             3.940704e+02
##                           factor(Policy_Sales_Channel)21
##                                             4.641702e+02
##                           factor(Policy_Sales_Channel)22
##                                             4.967703e+02
##                           factor(Policy_Sales_Channel)23
##                                             3.421569e+02
##                           factor(Policy_Sales_Channel)24
##                                             4.530014e+02
##                           factor(Policy_Sales_Channel)25
##                                             8.827071e+02
##                           factor(Policy_Sales_Channel)26
##                                             2.337729e+04
##                           factor(Policy_Sales_Channel)29
##                                             5.557260e+02
##                           factor(Policy_Sales_Channel)30
##                                             7.966093e+02
##                           factor(Policy_Sales_Channel)31
##                                             3.757629e+02
##                           factor(Policy_Sales_Channel)32
##                                             1.492152e+03
##                           factor(Policy_Sales_Channel)35
##                                             4.587784e+02
##                           factor(Policy_Sales_Channel)36
##                                             1.049862e+02
##                           factor(Policy_Sales_Channel)37
##                                             3.106972e+02
##                           factor(Policy_Sales_Channel)38
##                                             2.505826e+08
##                           factor(Policy_Sales_Channel)39
##                                             7.106624e+02
##                           factor(Policy_Sales_Channel)40
##                                             4.025689e+02
##                           factor(Policy_Sales_Channel)42
##                                             2.255261e+02
##                           factor(Policy_Sales_Channel)44
##                                             1.870020e+02
##                           factor(Policy_Sales_Channel)45
##                                             2.738820e+02
##                           factor(Policy_Sales_Channel)46
##                                             8.700932e+08
##                           factor(Policy_Sales_Channel)47
##                                             3.093844e+02
##                           factor(Policy_Sales_Channel)48
##                                             9.650566e+02
##                           factor(Policy_Sales_Channel)49
##                                             4.737585e+03
##                           factor(Policy_Sales_Channel)51
##                                             2.970590e+08
##                           factor(Policy_Sales_Channel)52
##                                             6.354737e+02
##                           factor(Policy_Sales_Channel)53
##                                             2.427014e+02
```

```
##                                factor(Policy_Sales_Channel)54
##                                                  2.645798e+02
##                                factor(Policy_Sales_Channel)55
##                                                  6.612887e+02
##                                factor(Policy_Sales_Channel)56
##                                                  2.604453e+02
##                                factor(Policy_Sales_Channel)57
##                                                  1.701481e+03
##                                factor(Policy_Sales_Channel)58
##                                                  1.657149e+09
##                                factor(Policy_Sales_Channel)59
##                                                  2.356870e+02
##                                factor(Policy_Sales_Channel)60
##                                                  4.967264e+02
##                                factor(Policy_Sales_Channel)61
##                                                  5.533811e+02
##                                factor(Policy_Sales_Channel)62
##                                                  5.479276e+08
##                                factor(Policy_Sales_Channel)63
##                                                  2.339008e+03
##                                factor(Policy_Sales_Channel)64
##                                                  8.997572e+02
##                                factor(Policy_Sales_Channel)65
##                                                  1.478785e+03
##                                factor(Policy_Sales_Channel)66
##                                                  1.729177e+03
##                                factor(Policy_Sales_Channel)69
##                                                  1.147293e+03
##                                factor(Policy_Sales_Channel)71
##                                                  6.944758e+08
##                                factor(Policy_Sales_Channel)73
##                                                  1.863870e+03
##                                factor(Policy_Sales_Channel)78
##                                                  1.936738e+02
##                                factor(Policy_Sales_Channel)79
##                                                  7.141652e+09
##                                factor(Policy_Sales_Channel)80
##                                                  2.981161e+02
##                                factor(Policy_Sales_Channel)81
##                                                  5.988945e+02
##                                factor(Policy_Sales_Channel)86
##                                                  7.078607e+02
##                                factor(Policy_Sales_Channel)87
##                                                  1.674653e+02
##                                factor(Policy_Sales_Channel)88
##                                                  9.326636e+02
##                                factor(Policy_Sales_Channel)89
##                                                  1.831236e+02
##                                factor(Policy_Sales_Channel)90
##                                                  3.512412e+02
##                                factor(Policy_Sales_Channel)91
##                                                  3.576254e+02
##                                factor(Policy_Sales_Channel)92
##                                                  7.798973e+02
```

```
##                              factor(Policy_Sales_Channel)93
##                                           8.425535e+02
##                              factor(Policy_Sales_Channel)94
##                                           2.440277e+02
##                              factor(Policy_Sales_Channel)95
##                                           2.283252e+08
##                              factor(Policy_Sales_Channel)96
##                                           3.522135e+08
##                              factor(Policy_Sales_Channel)97
##                                           7.706633e+02
##                              factor(Policy_Sales_Channel)98
##                                           2.662228e+03
##                              factor(Policy_Sales_Channel)99
##                                           1.048296e+09
##                             factor(Policy_Sales_Channel)100
##                                           1.644410e+03
##                             factor(Policy_Sales_Channel)101
##                                           1.332023e+03
##                             factor(Policy_Sales_Channel)103
##                                           4.522477e+02
##                             factor(Policy_Sales_Channel)104
##                                           1.218912e+09
##                             factor(Policy_Sales_Channel)106
##                                           1.874244e+02
##                             factor(Policy_Sales_Channel)107
##                                           3.239818e+03
##                             factor(Policy_Sales_Channel)108
##                                           3.962020e+04
##                             factor(Policy_Sales_Channel)109
##                                           3.747641e+02
##                             factor(Policy_Sales_Channel)110
##                                           3.648176e+08
##                             factor(Policy_Sales_Channel)111
##                                           6.825133e+02
##                             factor(Policy_Sales_Channel)113
##                                           7.843151e+02
##                             factor(Policy_Sales_Channel)114
##                                           2.776771e+02
##                             factor(Policy_Sales_Channel)116
##                                           5.284391e+02
##                             factor(Policy_Sales_Channel)117
##                                           2.027249e+08
##                             factor(Policy_Sales_Channel)118
##                                           3.342606e+08
##                             factor(Policy_Sales_Channel)119
##                                           1.149002e+03
##                             factor(Policy_Sales_Channel)120
##                                           6.333608e+02
##                             factor(Policy_Sales_Channel)121
##                                           2.586024e+02
##                             factor(Policy_Sales_Channel)122
##                                           3.688028e+03
##                             factor(Policy_Sales_Channel)124
##                                           2.215589e+04
```

```
##                               factor(Policy_Sales_Channel)125
##                                          6.101120e+02
##                               factor(Policy_Sales_Channel)126
##                                          3.163166e+09
##                               factor(Policy_Sales_Channel)127
##                                          4.308332e+02
##                               factor(Policy_Sales_Channel)128
##                                          5.621298e+02
##                               factor(Policy_Sales_Channel)129
##                                          2.709902e+02
##                               factor(Policy_Sales_Channel)130
##                                          1.651629e+08
##                               factor(Policy_Sales_Channel)131
##                                          2.154194e+02
##                               factor(Policy_Sales_Channel)132
##                                          3.800906e+02
##                               factor(Policy_Sales_Channel)133
##                                          6.477369e+02
##                               factor(Policy_Sales_Channel)134
##                                          2.734678e+08
##                               factor(Policy_Sales_Channel)135
##                                          2.501023e+02
##                               factor(Policy_Sales_Channel)136
##                                          1.758875e+02
##                               factor(Policy_Sales_Channel)137
##                                          2.314818e+09
##                               factor(Policy_Sales_Channel)138
##                                          4.317061e+02
##                               factor(Policy_Sales_Channel)139
##                                          2.718228e+02
##                               factor(Policy_Sales_Channel)140
##                                          3.980425e+02
##                               factor(Policy_Sales_Channel)145
##                                          2.717381e+02
##                               factor(Policy_Sales_Channel)146
##                                          1.603296e+08
##                               factor(Policy_Sales_Channel)147
##                                          1.774170e+02
##                               factor(Policy_Sales_Channel)148
##                                          2.680250e+02
##                               factor(Policy_Sales_Channel)150
##                                          2.302705e+02
##                               factor(Policy_Sales_Channel)151
##                                          2.432488e+03
##                               factor(Policy_Sales_Channel)152
##                                          3.188475e+04
##                               factor(Policy_Sales_Channel)153
##                                          8.109696e+02
##                               factor(Policy_Sales_Channel)154
##                                          2.255594e+03
##                               factor(Policy_Sales_Channel)155
##                                          5.241651e+02
##                               factor(Policy_Sales_Channel)156
##                                          3.893560e+03
```

```
##                             factor(Policy_Sales_Channel)157
##                                            2.495808e+03
##                             factor(Policy_Sales_Channel)158
##                                            2.285398e+02
##                             factor(Policy_Sales_Channel)159
##                                            7.462909e+03
##                             factor(Policy_Sales_Channel)160
##                                            8.032124e+03
##                             factor(Policy_Sales_Channel)163
##                                            1.111365e+03
##                                             Age:Vehicle_Age1
##                                            4.632545e+03
##                                             Age:Vehicle_Age2
##                                            9.897935e+02
## factor(Vehicle_Damage)1:factor(Previously_Insured)1
##                                            2.604750e+02
##                        Age:factor(Policy_Sales_Channel)3
##                                            5.381738e+02
##                        Age:factor(Policy_Sales_Channel)4
##                                            4.829641e+02
##                        Age:factor(Policy_Sales_Channel)7
##                                            1.375906e+03
##                        Age:factor(Policy_Sales_Channel)8
##                                            1.304154e+03
##                        Age:factor(Policy_Sales_Channel)9
##                                            5.805723e+02
##                       Age:factor(Policy_Sales_Channel)10
##                                            3.974522e+02
##                       Age:factor(Policy_Sales_Channel)11
##                                            1.186824e+03
##                       Age:factor(Policy_Sales_Channel)12
##                                            7.421868e+02
##                       Age:factor(Policy_Sales_Channel)13
##                                            1.418542e+03
##                       Age:factor(Policy_Sales_Channel)14
##                                            7.119524e+02
##                       Age:factor(Policy_Sales_Channel)15
##                                            9.164681e+02
##                       Age:factor(Policy_Sales_Channel)16
##                                            6.758581e+02
##                       Age:factor(Policy_Sales_Channel)17
##                                            3.065831e+02
##                       Age:factor(Policy_Sales_Channel)18
##                                            9.674505e+02
##                       Age:factor(Policy_Sales_Channel)19
##                                            6.396507e+02
##                       Age:factor(Policy_Sales_Channel)20
##                                            4.992353e+02
##                       Age:factor(Policy_Sales_Channel)21
##                                            6.470348e+02
##                       Age:factor(Policy_Sales_Channel)22
##                                            6.317572e+02
##                       Age:factor(Policy_Sales_Channel)23
##                                            5.196453e+02
```

```
##                      Age:factor(Policy_Sales_Channel)24
##                                             6.749333e+02
##                      Age:factor(Policy_Sales_Channel)25
##                                             1.443707e+03
##                      Age:factor(Policy_Sales_Channel)26
##                                             3.747630e+04
##                      Age:factor(Policy_Sales_Channel)29
##                                             7.230274e+02
##                      Age:factor(Policy_Sales_Channel)30
##                                             1.319192e+03
##                      Age:factor(Policy_Sales_Channel)31
##                                             4.604320e+02
##                      Age:factor(Policy_Sales_Channel)32
##                                             1.750977e+03
##                      Age:factor(Policy_Sales_Channel)35
##                                             5.196347e+02
##                      Age:factor(Policy_Sales_Channel)36
##                                             1.268521e+02
##                      Age:factor(Policy_Sales_Channel)37
##                                             3.979038e+02
##                      Age:factor(Policy_Sales_Channel)38
##                                             2.700574e+08
##                      Age:factor(Policy_Sales_Channel)39
##                                             8.403098e+02
##                      Age:factor(Policy_Sales_Channel)40
##                                             6.810357e+02
##                      Age:factor(Policy_Sales_Channel)42
##                                             2.709672e+02
##                      Age:factor(Policy_Sales_Channel)44
##                                             2.092213e+02
##                      Age:factor(Policy_Sales_Channel)45
##                                             2.787179e+02
##                      Age:factor(Policy_Sales_Channel)46
##                                             8.801130e+08
##                      Age:factor(Policy_Sales_Channel)47
##                                             3.285497e+02
##                      Age:factor(Policy_Sales_Channel)48
##                                             8.733647e+02
##                      Age:factor(Policy_Sales_Channel)49
##                                             6.828626e+03
##                      Age:factor(Policy_Sales_Channel)51
##                                             4.584455e+08
##                      Age:factor(Policy_Sales_Channel)52
##                                             9.367958e+02
##                      Age:factor(Policy_Sales_Channel)53
##                                             2.539844e+02
##                      Age:factor(Policy_Sales_Channel)54
##                                             3.319017e+02
##                      Age:factor(Policy_Sales_Channel)55
##                                             1.022549e+03
##                      Age:factor(Policy_Sales_Channel)56
##                                             2.969183e+02
##                      Age:factor(Policy_Sales_Channel)57
##                                             1.545143e+03
```

```
##                     Age:factor(Policy_Sales_Channel)58
##                                             1.118663e+09
##                     Age:factor(Policy_Sales_Channel)59
##                                             2.856802e+02
##                     Age:factor(Policy_Sales_Channel)60
##                                             6.406205e+02
##                     Age:factor(Policy_Sales_Channel)61
##                                             7.714935e+02
##                     Age:factor(Policy_Sales_Channel)62
##                                             6.677760e+08
##                     Age:factor(Policy_Sales_Channel)63
##                                             2.863346e+03
##                     Age:factor(Policy_Sales_Channel)64
##                                             1.053899e+03
##                     Age:factor(Policy_Sales_Channel)65
##                                             2.089392e+03
##                     Age:factor(Policy_Sales_Channel)66
##                                             1.629364e+03
##                     Age:factor(Policy_Sales_Channel)69
##                                             9.077973e+02
##                     Age:factor(Policy_Sales_Channel)71
##                                             6.791398e+08
##                     Age:factor(Policy_Sales_Channel)73
##                                             2.524181e+03
##                     Age:factor(Policy_Sales_Channel)78
##                                             2.156634e+02
##                     Age:factor(Policy_Sales_Channel)79
##                                             7.148059e+09
##                     Age:factor(Policy_Sales_Channel)80
##                                             3.155213e+02
##                     Age:factor(Policy_Sales_Channel)81
##                                             6.008010e+02
##                     Age:factor(Policy_Sales_Channel)86
##                                             9.571500e+02
##                     Age:factor(Policy_Sales_Channel)87
##                                             1.569690e+02
##                     Age:factor(Policy_Sales_Channel)88
##                                             1.035663e+03
##                     Age:factor(Policy_Sales_Channel)89
##                                             1.648298e+02
##                     Age:factor(Policy_Sales_Channel)90
##                                             3.662362e+02
##                     Age:factor(Policy_Sales_Channel)91
##                                             4.213302e+02
##                     Age:factor(Policy_Sales_Channel)92
##                                             9.746495e+02
##                     Age:factor(Policy_Sales_Channel)93
##                                             1.026333e+03
##                     Age:factor(Policy_Sales_Channel)94
##                                             2.901158e+02
##                     Age:factor(Policy_Sales_Channel)95
##                                             2.231061e+08
##                     Age:factor(Policy_Sales_Channel)96
##                                             3.517803e+08
```

```
##                 Age:factor(Policy_Sales_Channel)97
##                                       8.931560e+02
##                 Age:factor(Policy_Sales_Channel)98
##                                       4.342004e+03
##                 Age:factor(Policy_Sales_Channel)99
##                                       1.064909e+09
##                Age:factor(Policy_Sales_Channel)100
##                                       1.399963e+03
##                Age:factor(Policy_Sales_Channel)101
##                                       1.186896e+03
##                Age:factor(Policy_Sales_Channel)103
##                                       5.102796e+02
##                Age:factor(Policy_Sales_Channel)104
##                                       1.231929e+09
##                Age:factor(Policy_Sales_Channel)106
##                                       2.193315e+02
##                Age:factor(Policy_Sales_Channel)107
##                                       4.548200e+03
##                Age:factor(Policy_Sales_Channel)108
##                                       4.143266e+04
##                Age:factor(Policy_Sales_Channel)109
##                                       4.241395e+02
##                Age:factor(Policy_Sales_Channel)110
##                                       7.103391e+08
##                Age:factor(Policy_Sales_Channel)111
##                                       1.009678e+03
##                Age:factor(Policy_Sales_Channel)113
##                                       1.019060e+03
##                Age:factor(Policy_Sales_Channel)114
##                                       2.800596e+02
##                Age:factor(Policy_Sales_Channel)116
##                                       6.063661e+02
##                Age:factor(Policy_Sales_Channel)117
##                                       2.023732e+08
##                Age:factor(Policy_Sales_Channel)118
##                                       3.404413e+08
##                Age:factor(Policy_Sales_Channel)119
##                                       1.013034e+03
##                Age:factor(Policy_Sales_Channel)120
##                                       9.403091e+02
##                Age:factor(Policy_Sales_Channel)121
##                                       3.771965e+02
##                Age:factor(Policy_Sales_Channel)122
##                                       6.121319e+03
##                Age:factor(Policy_Sales_Channel)124
##                                       3.051943e+04
##                Age:factor(Policy_Sales_Channel)125
##                                       8.884937e+02
##                Age:factor(Policy_Sales_Channel)126
##                                       3.337197e+09
##                Age:factor(Policy_Sales_Channel)127
##                                       6.416594e+02
##                Age:factor(Policy_Sales_Channel)128
##                                       8.936861e+02
```

```
##                       Age:factor(Policy_Sales_Channel)129
##                                               3.847670e+02
##                       Age:factor(Policy_Sales_Channel)130
##                                               4.872618e+08
##                       Age:factor(Policy_Sales_Channel)131
##                                               2.529287e+02
##                       Age:factor(Policy_Sales_Channel)132
##                                               4.475106e+02
##                       Age:factor(Policy_Sales_Channel)133
##                                               6.390552e+02
##                       Age:factor(Policy_Sales_Channel)134
##                                               2.784863e+08
##                       Age:factor(Policy_Sales_Channel)135
##                                               3.184000e+02
##                       Age:factor(Policy_Sales_Channel)136
##                                               2.172984e+02
##                       Age:factor(Policy_Sales_Channel)137
##                                               2.395344e+09
##                       Age:factor(Policy_Sales_Channel)138
##                                               5.729340e+02
##                       Age:factor(Policy_Sales_Channel)139
##                                               3.077070e+02
##                       Age:factor(Policy_Sales_Channel)140
##                                               4.631920e+02
##                       Age:factor(Policy_Sales_Channel)145
##                                               3.437802e+02
##                       Age:factor(Policy_Sales_Channel)146
##                                               1.601018e+08
##                       Age:factor(Policy_Sales_Channel)147
##                                               2.518236e+02
##                       Age:factor(Policy_Sales_Channel)148
##                                               3.166066e+02
##                       Age:factor(Policy_Sales_Channel)150
##                                               2.689366e+02
##                       Age:factor(Policy_Sales_Channel)151
##                                               1.587166e+03
##                       Age:factor(Policy_Sales_Channel)152
##                                               1.381454e+04
##                       Age:factor(Policy_Sales_Channel)153
##                                               7.578021e+02
##                       Age:factor(Policy_Sales_Channel)154
##                                               2.326469e+03
##                       Age:factor(Policy_Sales_Channel)155
##                                               5.927227e+02
##                       Age:factor(Policy_Sales_Channel)156
##                                               3.806514e+03
##                       Age:factor(Policy_Sales_Channel)157
##                                               2.764620e+03
##                       Age:factor(Policy_Sales_Channel)158
##                                               2.658786e+02
##                       Age:factor(Policy_Sales_Channel)159
##                                               8.225907e+03
##                       Age:factor(Policy_Sales_Channel)160
##                                               3.112261e+03
```

```
##                         Age:factor(Policy_Sales_Channel)163
##                                            9.979255e+02
```

--------------------------------- Train Test Split ---------------------------------

```r
# Randomly assign 80% of data to the training set and train the logistic regression
## model using data. Then, test the model using the 20% data left to check the
## prediction accuracy. I performed this process five times using different random
## number seed and got the mean of the five accuracy numbers. I considered this
## average number as the final prediction accuracy of the model
set.seed(123)
indices1 = sample(nrow(data), 0.8 * nrow(data))
train_set1 = data[indices1, ]
test_set1 = data[-indices1, ]

glm_train1 = glm(Response ~ Gender + factor(Driving_License) + factor(Region_Code) +
                factor(Previously_Insured) * factor(Vehicle_Damage) + Vehicle_Age * Age +
                Annual_Premium + factor(Policy_Sales_Channel),
                data = train_set1, family = binomial(link = 'logit'))

res1 = data.frame(predict(glm_train1, newdata = test_set1))
t_res1 = c()
for (i in 1: nrow(res1)) {
  if (res1[i,] < 0.5) {
    t_res1 = c(t_res1, 0)
  }
  else {
    t_res1 = c(t_res1, 1)
  }
}
accuracy1 = sum(data.frame(t_res1) == test_set1[, 'Response']) / nrow(test_set1)
accuracy1
```

```
## [1] 0.8764582
```

```r
set.seed(124)
indices2 = sample(nrow(data), 0.8 * nrow(data))
train_set2 = data[indices2,]
test_set2 = data[-indices2,]

glm_train2 = glm(Response ~ Gender + factor(Driving_License) + factor(Region_Code) +
                factor(Previously_Insured) * factor(Vehicle_Damage) + Vehicle_Age * Age +
                Annual_Premium + factor(Policy_Sales_Channel), data = train_set2,
                family = binomial(link = 'logit'))

res2 = data.frame(predict(glm_train2, newdata = test_set2))
t_res2 = c()
for (i in 1: nrow(res2)) {
  if (res2[i,] < 0.5) {
    t_res2 = c(t_res2, 0)
  }
  else {
    t_res2 = c(t_res2, 1)
```

```
  }
}
accuracy2 = sum(data.frame(t_res2) == test_set2[, 'Response']) / nrow(test_set2)
accuracy2
```

[1] 0.8759989

```
set.seed(125)
indices3 = sample(nrow(data), 0.8 * nrow(data))
train_set3=data[indices3,]
test_set3=data[-indices3,]

glm_train3 = glm(Response ~ Gender + factor(Driving_License) + factor(Region_Code) +
                factor(Previously_Insured) * factor(Vehicle_Damage) + Vehicle_Age * Age +
                Annual_Premium + factor(Policy_Sales_Channel), data = train_set3,
                family = binomial(link = 'logit'))

res3 = data.frame(predict(glm_train3, newdata = test_set3))
t_res3 = c()
for (i in 1: nrow(res3)) {
  if (res3[i,] < 0.5) {
    t_res3 = c(t_res3, 0)
  }
  else {
    t_res3 = c(t_res3, 1)
  }
}
accuracy3 = sum(data.frame(t_res3) == test_set3[, 11]) / 76222
accuracy3
```

[1] 0.877004

```
set.seed(126)
indices4 = sample(nrow(data), 0.8 * nrow(data))
train_set4=data[indices4,]
test_set4=data[-indices4,]

glm_train4 = glm(Response ~ Gender + factor(Driving_License) + factor(Region_Code) +
                factor(Previously_Insured) * factor(Vehicle_Damage) + Vehicle_Age * Age +
                Annual_Premium + factor(Policy_Sales_Channel), data = train_set4,
                family = binomial(link = 'logit'))

res4 = data.frame(predict(glm_train4, newdata = test_set4))
t_res4 = c()
for (i in 1: nrow(res4)) {
  if (res4[i,] < 0.5) {
    t_res4 = c(t_res4, 0)
  }
  else {
    t_res4 = c(t_res4, 1)
  }
}
```

```
accuracy4 = sum(data.frame(t_res4) == test_set4[, 11]) / 76222
accuracy4
```

[1] 0.8769778

```
set.seed(127)
indices5 = sample(nrow(data), 0.8 * nrow(data))
train_set5=data[indices5,]
test_set5=data[-indices5,]

glm_train5 = glm(Response ~ Gender + factor(Driving_License) + factor(Region_Code) +
              factor(Previously_Insured) * factor(Vehicle_Damage) + Vehicle_Age * Age +
              Annual_Premium + factor(Policy_Sales_Channel), data = train_set5,
              family = binomial(link = 'logit'))

res5 = data.frame(predict(glm_train5, newdata = test_set5))
t_res5 = c()
for (i in 1: nrow(res5)) {
  if (res5[i,] < 0.5) {
    t_res5 = c(t_res5, 0)
  }
  else {
    t_res5 = c(t_res5, 1)
  }
}
accuracy5 = sum(data.frame(t_res5) == test_set5[, 11]) / 76222
accuracy5
```

[1] 0.8780929

```
mean(accuracy1, accuracy2, accuracy3, accuracy4, accuracy5)
```

[1] 0.8764582