```
library(readxl) #for loading Excel files
library(readr)
library(dplyr) #for data processing/cleaning
```

```
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
```

```
library(tidyr) #for data processing/cleaning
library(skimr) #for nice visualization of data
library(here) #to set paths
```

```
here() starts at /Users/srilakshmi/Documents/GitHub/GANNI-PII-project/data-analysis-template-main
```

```
library(tidyverse)
```

```
── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──
✔ forcats   1.0.0     ✔ purrr     1.0.2
✔ ggplot2   3.4.3     ✔ stringr   1.5.0
✔ lubridate 1.9.2     ✔ tibble    3.2.1

── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
✖ dplyr::filter() masks stats::filter()
✖ dplyr::lag()    masks stats::lag()
ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(ggplot2)
library(tidycensus)
```

```
getwd()
```

```
[1] "/Users/srilakshmi/Documents/GitHub/GANNI-PII-project/data-analysis-template-main/code"
```

```
# Import Data, Check Descriptive Statistics & Data Types
data_location <- here::here("Electric_Vehicle_Population_Data.csv")
```

```
ev_data <- read.csv(data_location)
summary(ev_data)
```

```
 VIN..1.10.           County              City              State
Length:181458      Length:181458      Length:181458      Length:181458
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character




 Postal.Code      Model.Year       Make              Model
Min.   : 1545   Min.   :1997   Length:181458      Length:181458
1st Qu.:98052   1st Qu.:2019   Class :character   Class :character
Median :98122   Median :2022   Mode  :character   Mode  :character
Mean   :98174   Mean   :2021
3rd Qu.:98370   3rd Qu.:2023
Max.   :99577   Max.   :2024
NA's   :3
Electric.Vehicle.Type Clean.Alternative.Fuel.Vehicle..CAFV..Eligibility
Length:181458         Length:181458
Class :character      Class :character
Mode  :character      Mode  :character




 Electric.Range     Base.MSRP      Legislative.District DOL.Vehicle.ID
Min.   :  0.00   Min.   :     0   Min.   : 1.00        Min.   :     4385
1st Qu.:  0.00   1st Qu.:     0   1st Qu.:18.00        1st Qu.:183068667
Median :  0.00   Median :     0   Median :33.00        Median :228915522
Mean   : 57.83   Mean   :  1040   Mean   :29.11        Mean   :221412778
3rd Qu.: 75.00   3rd Qu.:     0   3rd Qu.:42.00        3rd Qu.:256131982
Max.   :337.00   Max.   :845000   Max.   :49.00        Max.   :479254772
                                  NA's   :398
 Vehicle.Location   Electric.Utility   X2020.Census.Tract
Length:181458      Length:181458      Min.   :1.001e+09
Class :character   Class :character   1st Qu.:5.303e+10
Mode  :character   Mode  :character   Median :5.303e+10
                                      Mean   :5.298e+10
                                      3rd Qu.:5.305e+10
                                      Max.   :5.603e+10
                                      NA's   :3
```

```
dplyr::glimpse(ev_data)
```

```
Rows: 181,458
Columns: 17
$ VIN..1.10.                                        <chr> "WAUTPBFF4H", "WAUUP…
$ County                                            <chr> "King", "Thurston", …
```

```
$ City                                                <chr> "Seattle", "Olympia"…
$ State                                               <chr> "WA", "WA", "WA", "W…
$ Postal.Code                                         <int> 98126, 98502, 98516,…
$ Model.Year                                          <int> 2017, 2018, 2017, 20…
$ Make                                                <chr> "AUDI", "AUDI", "TES…
$ Model                                               <chr> "A3", "A3", "MODEL S…
$ Electric.Vehicle.Type                               <chr> "Plug-in Hybrid Elec…
$ Clean.Alternative.Fuel.Vehicle..CAFV..Eligibility <chr> "Not eligible due to…
$ Electric.Range                                      <int> 16, 16, 210, 25, 308…
$ Base.MSRP                                           <int> 0, 0, 0, 0, 0, 0, 0,…
$ Legislative.District                                <int> 34, 22, 22, 20, 14, …
$ DOL.Vehicle.ID                                      <int> 235085336, 237896795…
$ Vehicle.Location                                    <chr> "POINT (-122.374105 …
$ Electric.Utility                                    <chr> "CITY OF SEATTLE - (…
$ X2020.Census.Tract                                  <dbl> 53033011500, 5306701…
```

```r
# Checking for duplicates:
duplicates <- duplicated(ev_data) # Check for duplicates
num_duplicates <- sum(duplicates) # Count of duplicates
print(num_duplicates)
```

```
[1] 0
```

```r
# Find total rows with MSRP prices
count_zero_msrp = length(which(ev_data$Base.MSRP == 0))
total_rows_count = nrow(ev_data)
total_price_data_points = total_rows_count - count_zero_msrp
print(paste0('Total rows: ', total_rows_count))
```

```
[1] "Total rows: 181458"
```

```r
print(paste0('Total Missing MSRP Prices: ', count_zero_msrp))
```

```
[1] "Total Missing MSRP Prices: 178146"
```

```r
print(paste0('Total Price Data Points: ', total_price_data_points))
```

```
[1] "Total Price Data Points: 3312"
```

```r
# Checking for Null values:
total_na <- sum(is.na(ev_data))
print(total_na)
```

```
[1] 404
```

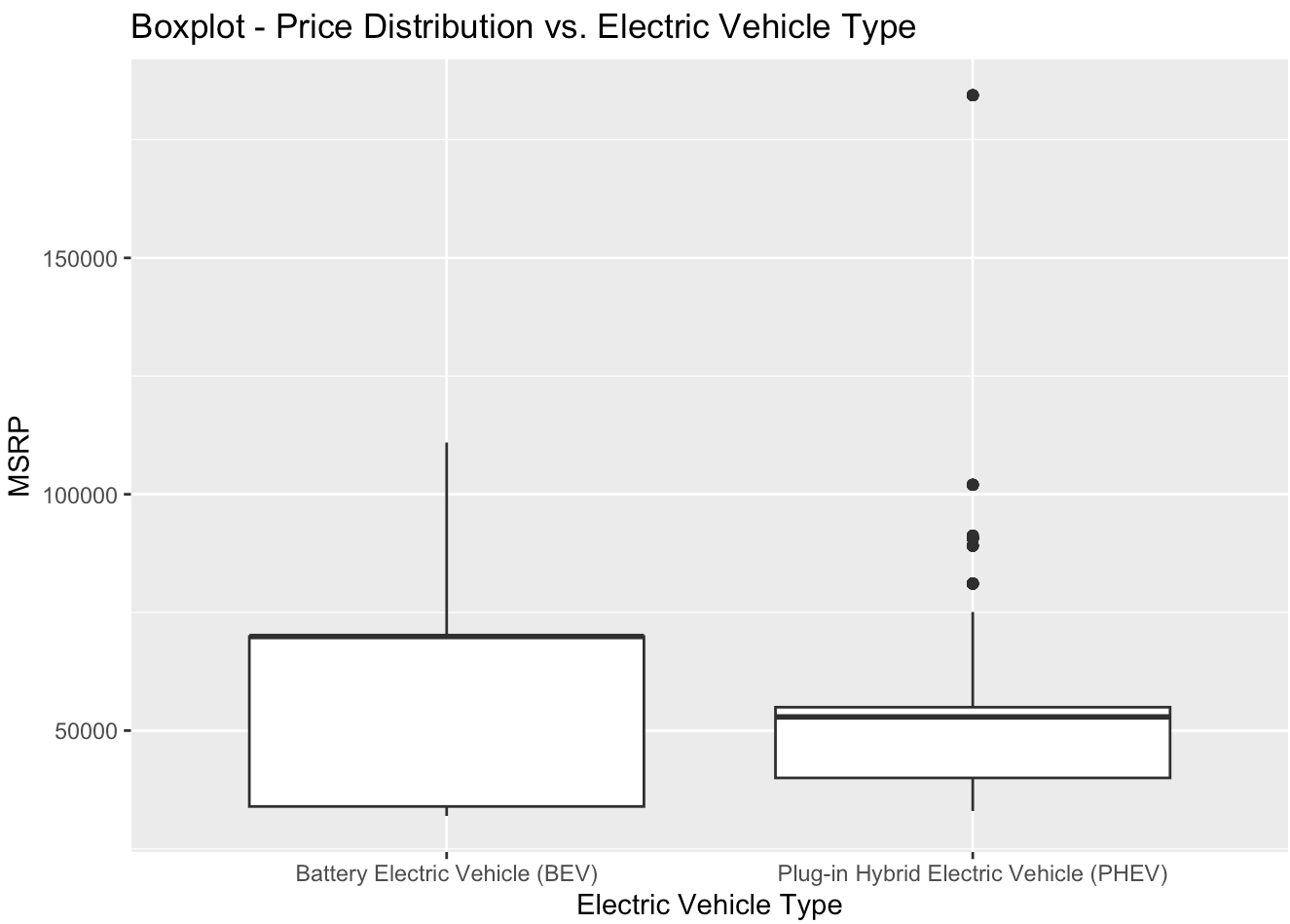
```r
# Removing null values and outlier from MSRP:
ev_data_filtered <- na.omit(ev_data) # FIltered data with NA values removed
max_msrp_outlier <- ev_data_filtered %>%
```

```
  group_by(Electric.Vehicle.Type) %>%
  summarise(max = max(Base.MSRP))
max_msrp_outlier
```

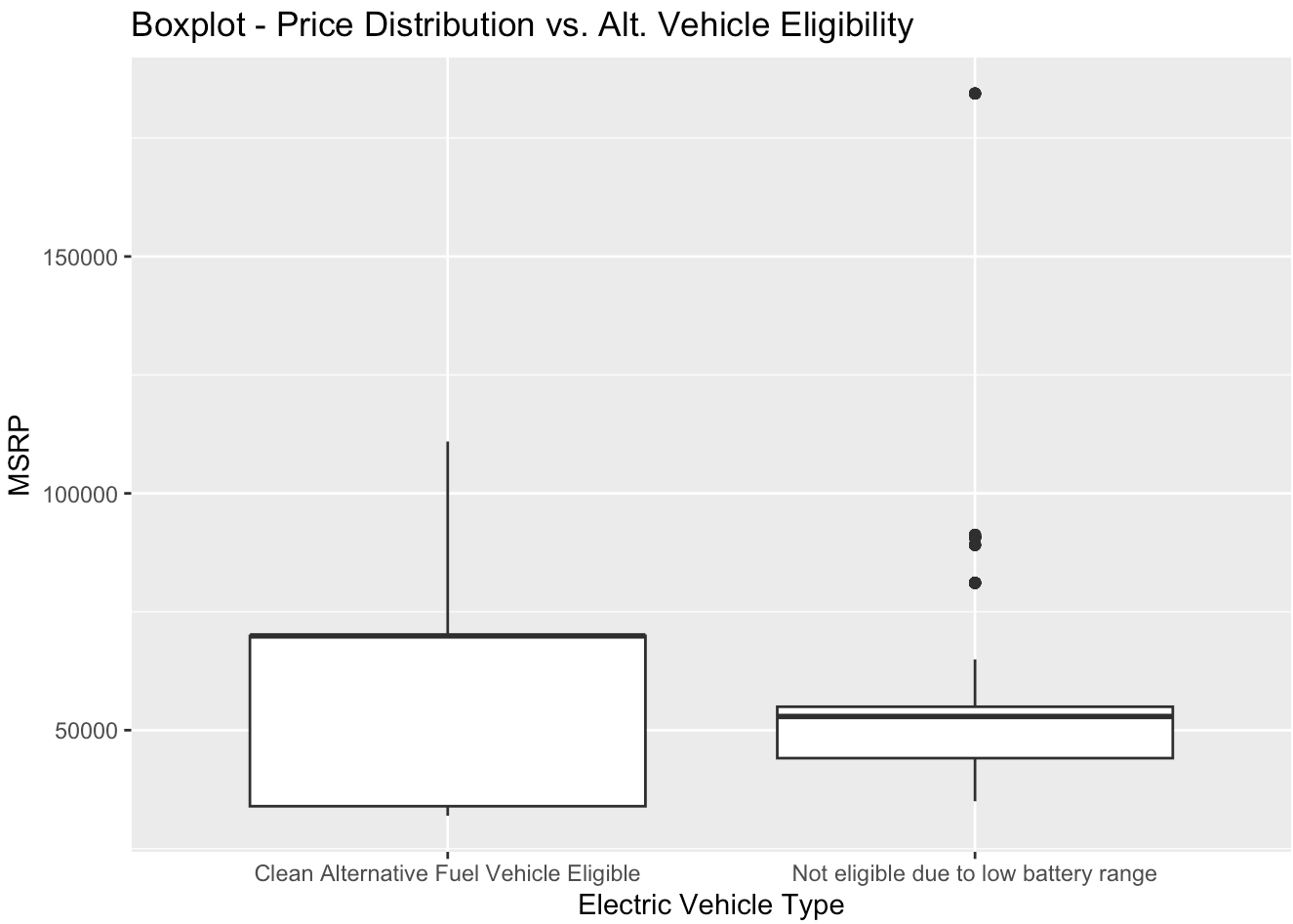
```
# A tibble: 2 × 2
  Electric.Vehicle.Type                  max
  <chr>                                <int>
1 Battery Electric Vehicle (BEV)      110950
2 Plug-in Hybrid Electric Vehicle (PHEV) 845000
```

```
filter_msrp_outlier <- ev_data_filtered %>%
  filter(Base.MSRP != 845000) %>%
  filter(Base.MSRP != 0)
#filter_msrp_outlier
```

```
# Create a boxplot of price distribution by electric vehicle type
p2_boxplot<-ggplot(filter_msrp_outlier, aes(x = Electric.Vehicle.Type, y = Base.MSRP)) +
  geom_boxplot() +
  labs(title = "Boxplot - Price Distribution vs. Electric Vehicle Type",
       x = "Electric Vehicle Type",
       y = "MSRP")
p2_boxplot
```

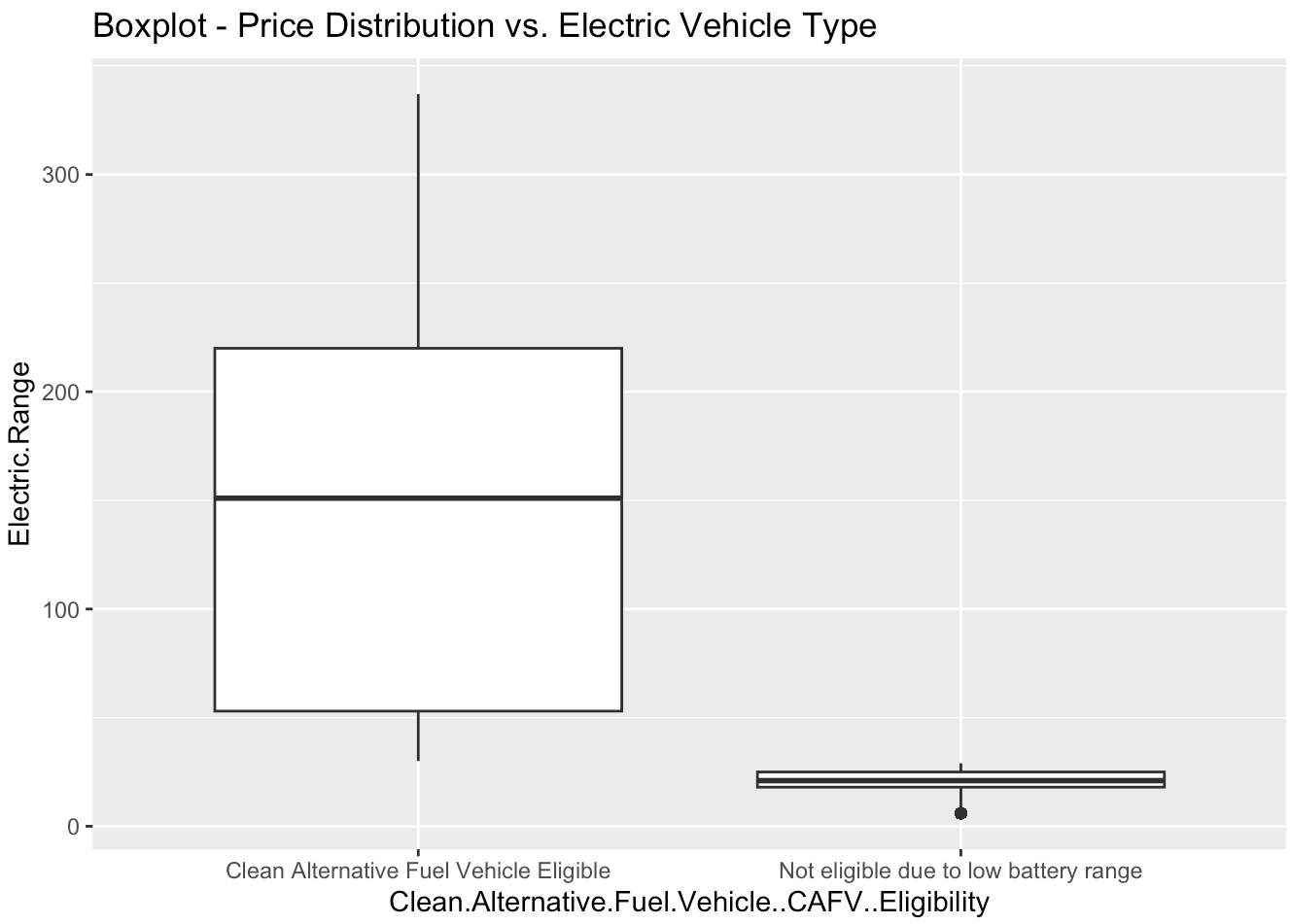


```
# Clean data for plot
price_by_state = ev_data_filtered %>%
  group_by(Clean.Alternative.Fuel.Vehicle..CAFV..Eligibility) %>%
  filter(Base.MSRP != 0) %>%
  filter(Base.MSRP != 845000)

# Create a boxplot for price distribution by alternative fuel eligibility
p3_boxplot<-ggplot(price_by_state, aes(x = Clean.Alternative.Fuel.Vehicle..CAFV..Eligibil
  geom_boxplot() +
  labs(title = "Boxplot - Price Distribution vs. Alt. Vehicle Eligibility",
       x = "Electric Vehicle Type",
       y = "MSRP")
p3_boxplot
```

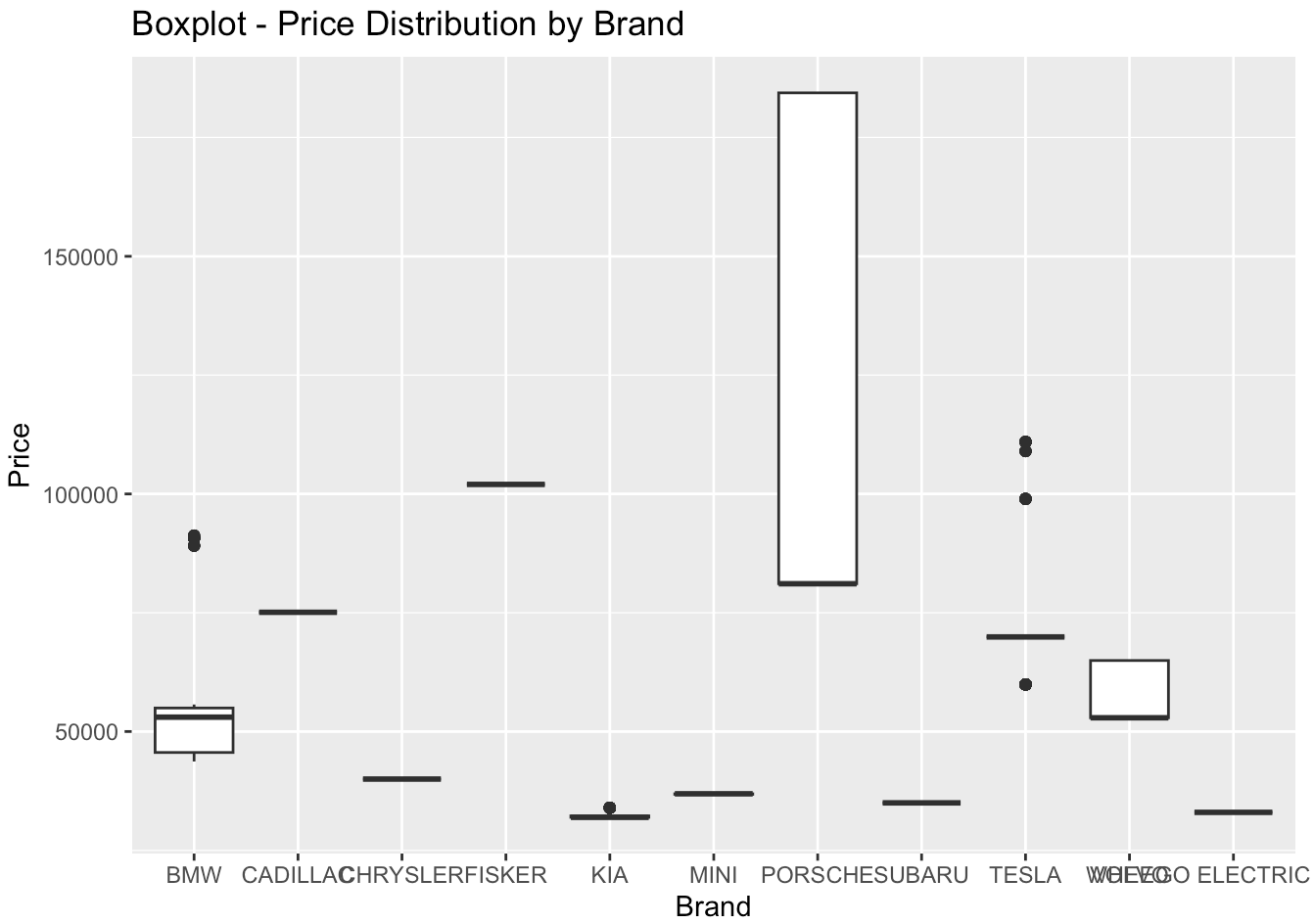



```
# Clean data from plot
price_by_state = ev_data_filtered %>%
  group_by(Clean.Alternative.Fuel.Vehicle..CAFV..Eligibility) %>%
  filter(Electric.Range != 0)

# Create a boxplot
p4_boxplot<-ggplot(price_by_state, aes(x = Clean.Alternative.Fuel.Vehicle..CAFV..Eligibil
  geom_boxplot() +
```

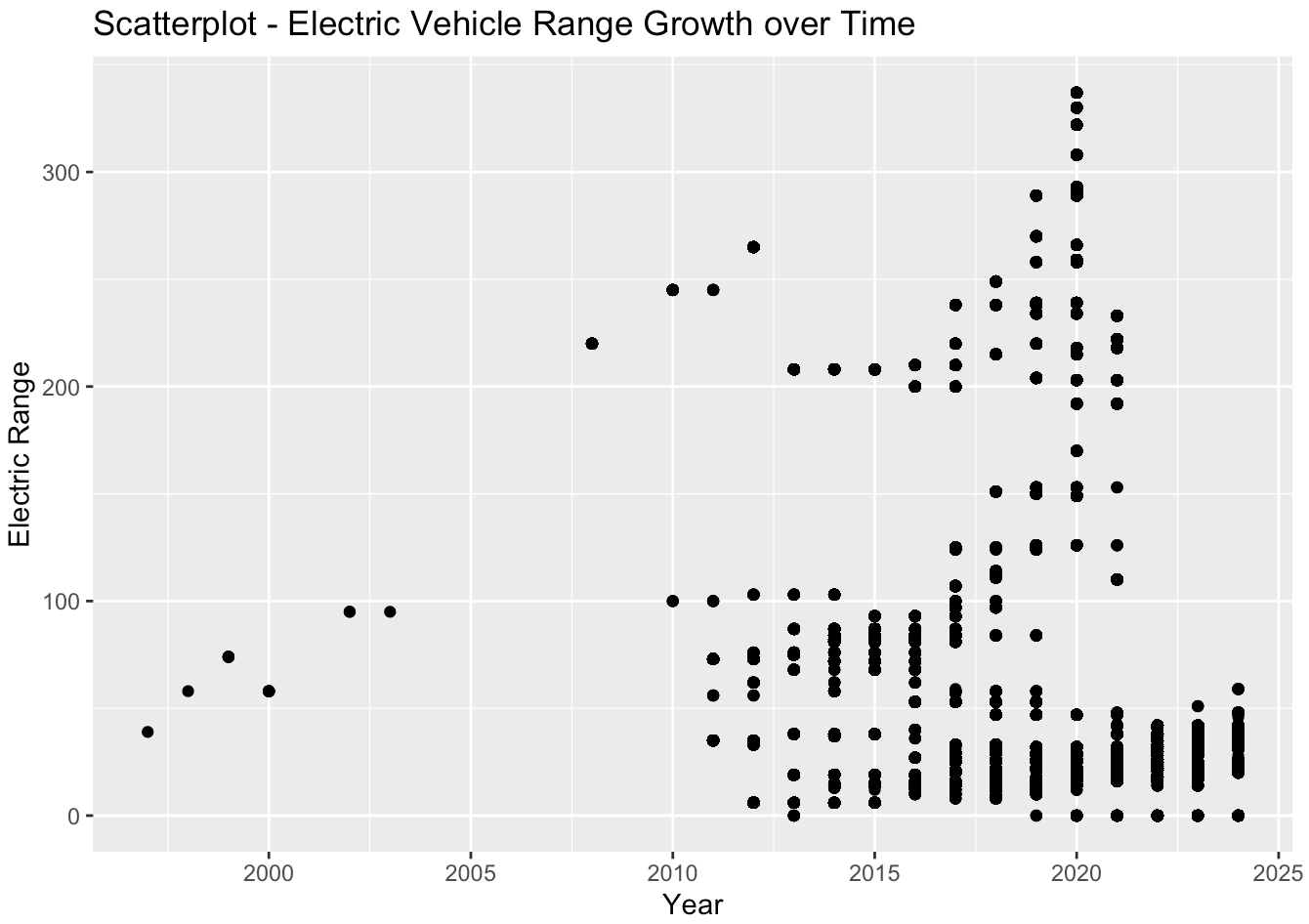
```
  labs(title = "Boxplot - Price Distribution vs. Electric Vehicle Type")
p4_boxplot
```




```
# Create a boxplot with the new categorical variable on the x-axis and height on the y-ax
p_boxplot<-ggplot(filter_msrp_outlier, aes(x = Make, y = Base.MSRP)) +
  geom_boxplot() +
  labs(title = "Boxplot - Price Distribution by Brand",
       x = "Brand",
       y = "Price")
p_boxplot
```

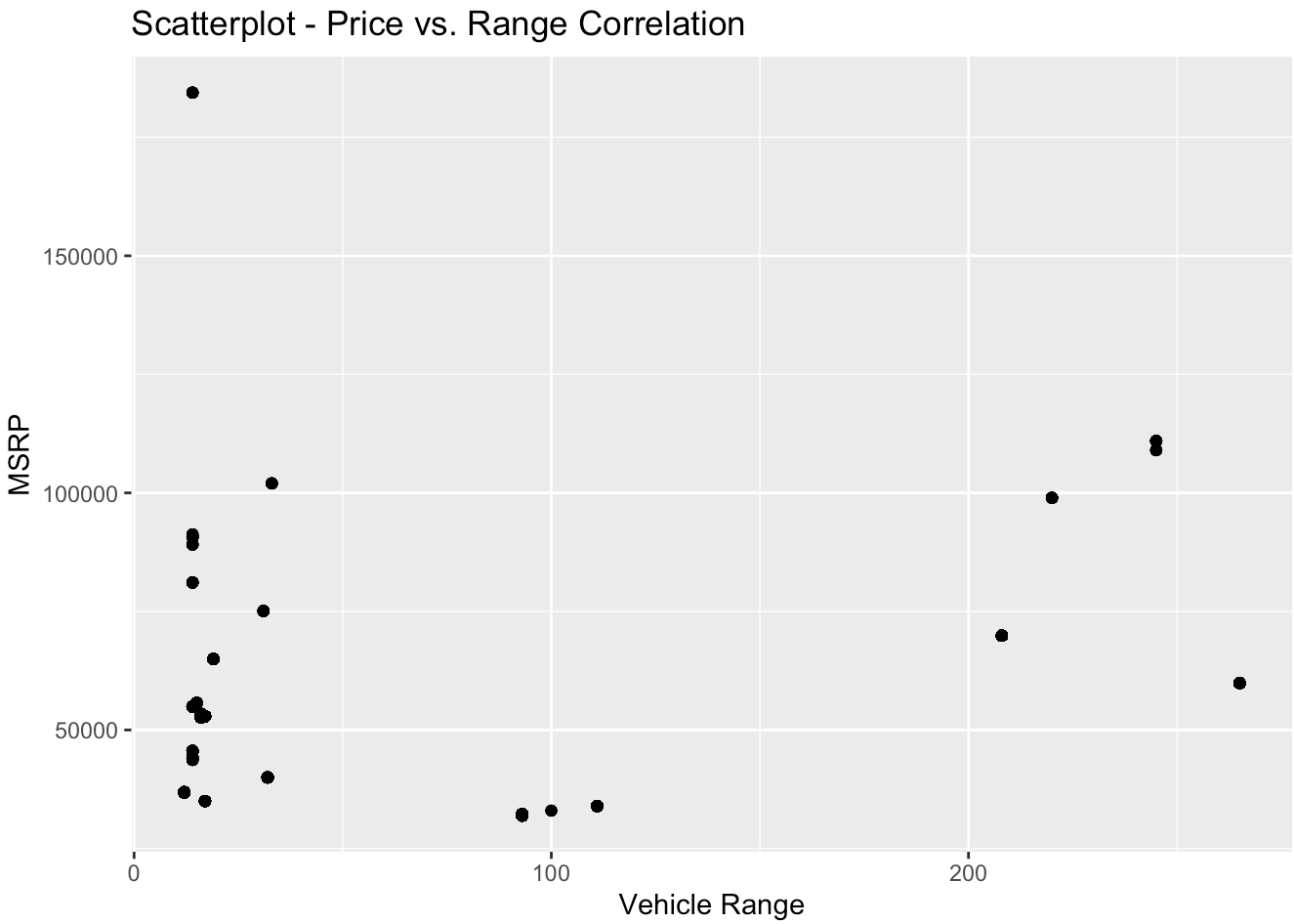



```
# Create a scatterplot with electric vehicle range growth over time

p_scatterplot<-ggplot(ev_data_filtered, aes(x = Model.Year, y = Electric.Range)) +
  geom_point() +
  labs(title = "Scatterplot - Electric Vehicle Range Growth over Time",
       x = "Year",
       y = "Electric Range")
plot(p_scatterplot)
```




```
# Save the scatterplot to a file
# ggsave("scatterplot.png", plot = p_scatterplot)
```

```
# Create a scatterplot - price vs. electric vehicle range correlation

p_scatterplot<-ggplot(filter_msrp_outlier, aes(x = Electric.Range, y = Base.MSRP)) +
  geom_point() +
  labs(title = "Scatterplot - Price vs. Range Correlation",
       x = "Vehicle Range",
       y = "MSRP")
plot(p_scatterplot)
```




```
#For Electric.Range:
Q1 <- quantile(ev_data_filtered$Electric.Range , 0.25, na.rm = TRUE) # First Quartile
Q3 <- quantile(ev_data_filtered$Electric.Range , 0.75, na.rm = TRUE) # Third Quartile
IQR <- Q3 - Q1 # Compute Interquartile Range
lower_bound <- Q1 - 1.5 * IQR # Compute Lower Bound based on IQR
upper_bound <- Q3 + 1.5 * IQR # Compute Upper Bound based on IQR
upper_bound
```

```
  75%
187.5
```

```
# Filter out outliers:
ev_data_Filtered_2 <- ev_data_filtered[ev_data_filtered$Electric.Range > lower_bound & ev
#ev_data_Filtered_2
```