Project

```r
# Load libraries
library(ggplot2)
library(dplyr)
library(lubridate)
library(tidyr)

# Read the data from CSV
data <- read.csv("data.csv")

# Convert Date to Date format
data$Date <- as.Date(data$Date)

# Extract month and year for time-based analysis
data$Year <- year(data$Date)
data$Month <- month(data$Date)
data$Season <- case_when(
  data$Month %in% 3:5  ~ "Spring",
  data$Month %in% 6:8  ~ "Summer",
  data$Month %in% 9:11 ~ "Autumn",
  TRUE                 ~ "Winter"
)
# For temperature, you may need to clean/remove the "C" symbol and convert them to numeric values
data$Day.Temp <- as.numeric(gsub("C", "", data$Day.Temp))
data$Night.Temp <- as.numeric(gsub("C", "", data$Night.Temp))


data <- data %>%
  filter(Day.Weather != "" & Day.Weather != "-") %>%
  filter(Night.Weather != "" & Night.Weather != "-") %>%
  filter(Day.Wind.Force != "Unknown" & Night.Wind.Force != "Unknown")


# Function to categorize wind force levels
categorize_wind_force <- function(force) {
  if (force == "Unknown") {
    return("0")
  } else if (grepl(" 3 |3 |1-2 ", force)) {
    return("0-3")
  } else if (grepl("3-4 |4 |4-5 |5-6 |5 |6 ", force)) {
    return("3-6")
  } else if (grepl("6-7 |8-9 |7-8 ", force)) {
    return("6-9")
  } else if (grepl("9-10 |10-11 |11-12 ", force)) {
    return("9-12")
  } else {
    return(NA)
```

```
  }
}

# Apply the function to both Day_Wind_Force and Night_Wind_Force columns
data <- data %>%
  mutate(
    Day_Wind_Force_Category = sapply(Day.Wind.Force, categorize_wind_force),
    Night_Wind_Force_Category = sapply(Night.Wind.Force, categorize_wind_force)
  )

# View the updated dataframe
print(head(data))
```

```
##         Date    City Weather.Condition Temperature
## 1 2011-01-01 beijing              /       0℃/-9℃
## 2 2011-01-02 beijing             /      -2℃/-7℃
## 3 2011-01-03 beijing              /       1℃/-8℃
## 4 2011-01-04 beijing              /     -1℃/-11℃
## 5 2011-01-05 beijing              /      -1℃/-8℃
## 6 2011-01-06 beijing              /      0℃/-10℃
##        Wind.Force.and.Direction Day.Weather Night.Weather Day.Temp Night.Temp
## 1    3 /   3                                  0         -9
## 2    3 /   3                                -2         -7
## 3       3-4 /   3                                   1         -8
## 4    3 /   3                                 -1        -11
## 5           4-5 / 3-4                                  -1         -8
## 6    3 /   3                                  0        -10
##   Day.Wind.Direction Night.Wind.Direction Day.Wind.Force Night.Wind.Force Year
## 1                                       3              3  2011
## 2                                       3              3  2011
## 3                                     3-4                3  2011
## 4                                       3              3  2011
## 5                                             4-5              3-4  2011
## 6                                       3              3  2011
##   Month Season Day_Wind_Force_Category Night_Wind_Force_Category
## 1     1 Winter                     0-3                       0-3
## 2     1 Winter                     0-3                       0-3
## 3     1 Winter                     3-6                       0-3
## 4     1 Winter                     0-3                       0-3
## 5     1 Winter                     3-6                       3-6
## 6     1 Winter                     0-3                       0-3
```

```
# Summary statistics for temperature (Day and Night)
summary_stats <- data %>%
  group_by(City) %>%
  summarise(
    Day_Temperature_Mean = mean(Day.Temp, na.rm = TRUE),
    Night_Temperature_Mean = mean(Night.Temp, na.rm = TRUE),
    Day_Temperature_Median = median(Day.Temp, na.rm = TRUE),
    Night_Temperature_Median = median(Night.Temp, na.rm = TRUE),
    Day_Temperature_Min = min(Day.Temp, na.rm = TRUE),
    Night_Temperature_Min = min(Night.Temp, na.rm = TRUE),
    Day_Temperature_Max = max(Day.Temp, na.rm = TRUE),
```

```
    Night_Temperature_Max = max(Night.Temp, na.rm = TRUE)
  )
print(summary_stats)
```

```
## # A tibble: 4 x 9
##   City     Day_Temperature_Mean Night_Temperature_Mean Day_Temperature_Median
##   <chr>                   <dbl>                  <dbl>                    <dbl>
## 1 beijing                  18.9                   8.55                       20
## 2 haikou                   28.6                  22.2                        30
## 3 lasa                     17.1                   3.43                       17
## 4 shanghai                 21.2                  14.9                        22
## # i 5 more variables: Night_Temperature_Median <dbl>,
## #   Day_Temperature_Min <dbl>, Night_Temperature_Min <dbl>,
## #   Day_Temperature_Max <dbl>, Night_Temperature_Max <dbl>
```

```
# Combine both Day and Night wind force categories into one column for analysis
df_long <- data %>%
  gather(key = "Time_of_Day", value = "Wind_Force_Category", Day_Wind_Force_Category, Night_Wind_Force_C

# Summary statistics: count of wind force categories per city
summary_stats <- df_long %>%
  group_by(City, Wind_Force_Category) %>%
  summarise(Count = n()) %>%
  arrange(City, Wind_Force_Category)

# Print summary statistics
print(summary_stats)
```

```
## # A tibble: 13 x 3
## # Groups:   City [4]
##    City     Wind_Force_Category Count
##    <chr>    <chr>               <int>
##  1 beijing  0-3                  5634
##  2 beijing  3-6                  1622
##  3 beijing  6-9                     2
##  4 haikou   0-3                  2571
##  5 haikou   3-6                  4671
##  6 haikou   6-9                    36
##  7 haikou   9-12                   14
##  8 lasa     0-3                  6136
##  9 lasa     3-6                   621
## 10 lasa     6-9                     1
## 11 shanghai 0-3                  2994
## 12 shanghai 3-6                  4273
## 13 shanghai 6-9                    21
```

```
# Wind force summary statistics
wind_stats <- data %>%
  group_by(City) %>%
  summarise(
    Day_Wind_Force_Mean = mean(Day.Wind.Force, na.rm = TRUE),
    Night_Wind_Force_Mean = mean(Night.Wind.Force, na.rm = TRUE),
```

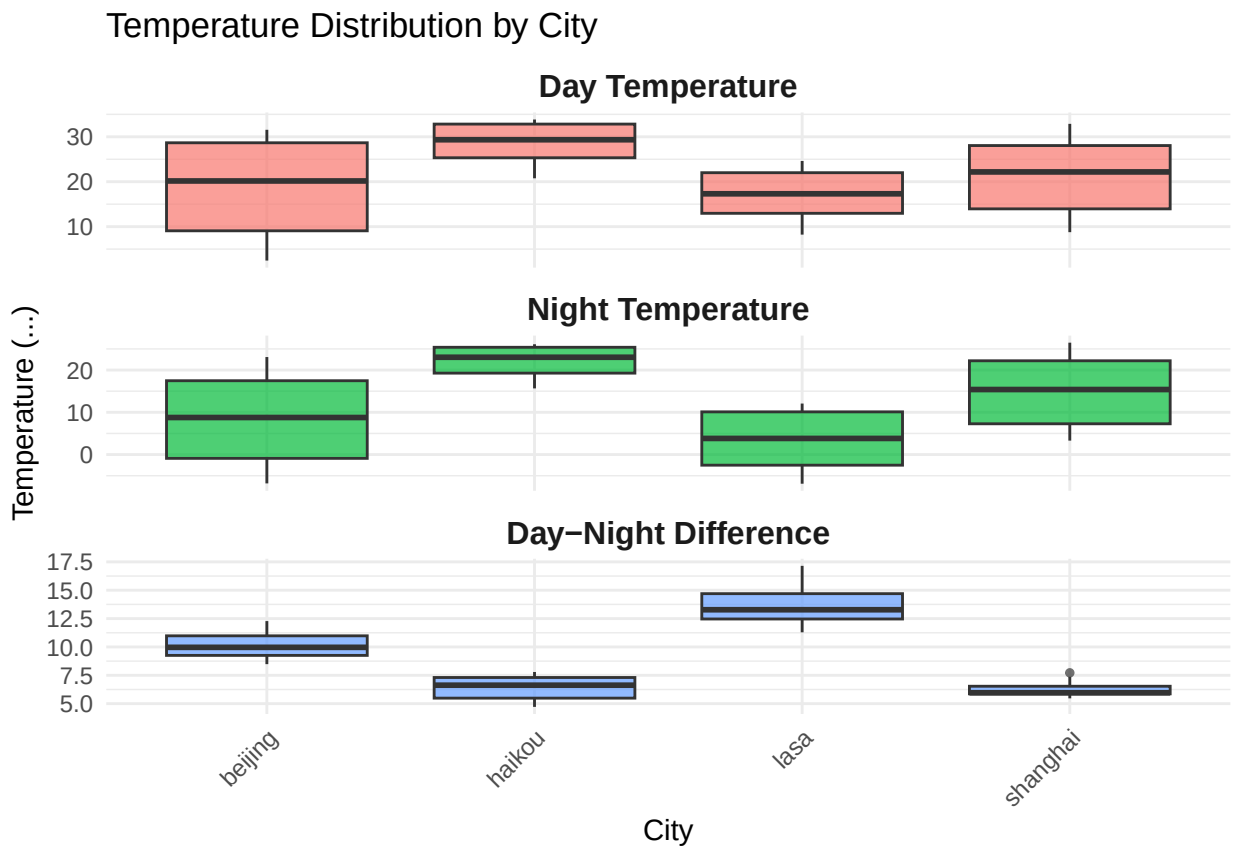
```
    Day_Wind_Force_Max = max(Day.Wind.Force, na.rm = TRUE),
    Night_Wind_Force_Max = max(Night.Wind.Force, na.rm = TRUE)
  )
print(wind_stats)
```

```
## # A tibble: 4 x 5
##   City     Day_Wind_Force_Mean Night_Wind_Force_Mean Day_Wind_Force_Max
##   <chr>                  <dbl>                 <dbl> <chr>
## 1 beijing                   NA                    NA 6
## 2 haikou                    NA                    NA 9-10
## 3 lasa                      NA                    NA 6
## 4 shanghai                  NA                    NA 8-9
## # i 1 more variable: Night_Wind_Force_Max <chr>
```

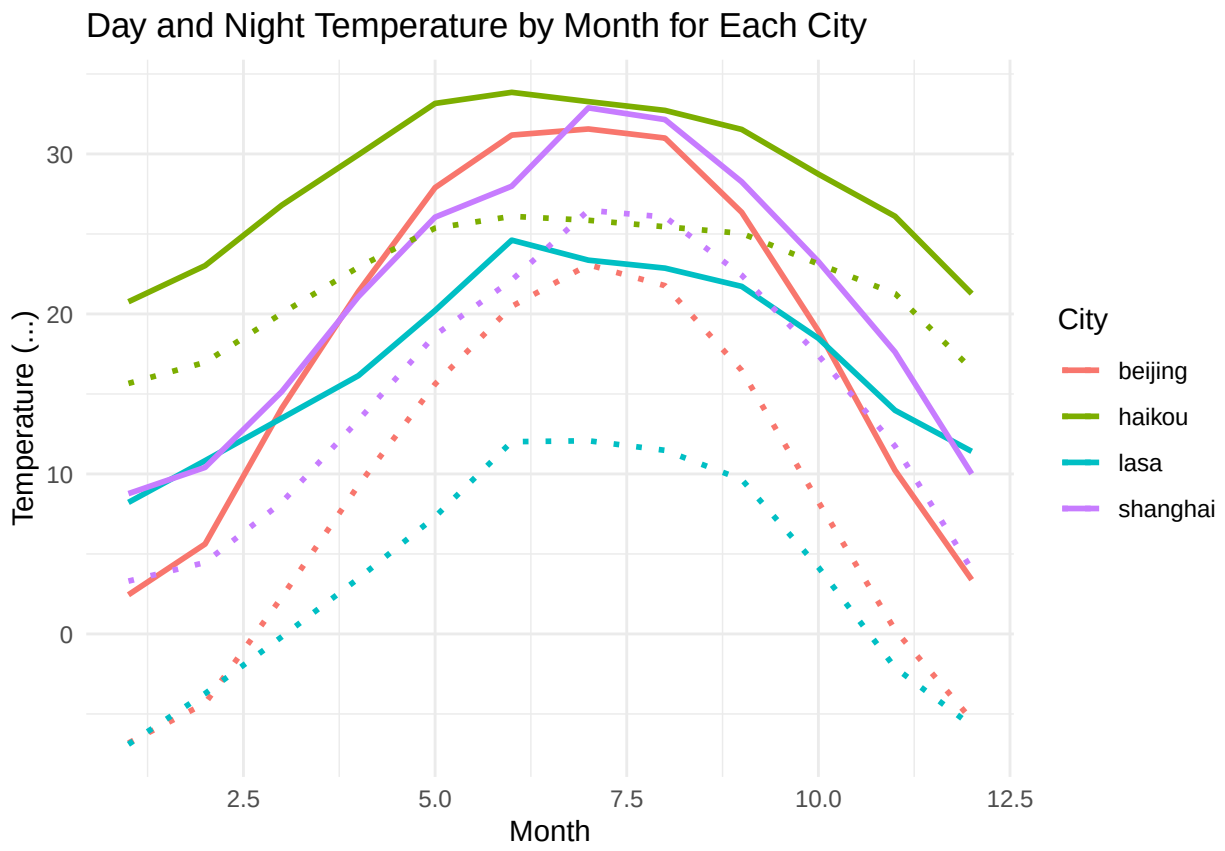
```
temperature_by_month <- data %>%
  group_by(City, Month) %>%
  summarise(
    Average_Day_Temperature = mean(Day.Temp, na.rm = TRUE),
    Average_Night_Temperature = mean(Night.Temp, na.rm = TRUE)
  ) %>%
  mutate(Day_Night_Temp_Difference = Average_Day_Temperature - Average_Night_Temperature)

# Calculate yearly averages and temperature difference
temperature_by_year <- data %>%
  group_by(City, Year) %>%
  summarise(
    Average_Day_Temperature = mean(Day.Temp, na.rm = TRUE),
    Average_Night_Temperature = mean(Night.Temp, na.rm = TRUE)
  ) %>%
  mutate(Day_Night_Temp_Difference = Average_Day_Temperature - Average_Night_Temperature)
```

```
# Reshape temperature_by_month for plotting
temperature_long_city <- temperature_by_month %>%
  pivot_longer(
    cols = c(Average_Day_Temperature, Average_Night_Temperature, Day_Night_Temp_Difference),
    names_to = "Temperature_Type",
    values_to = "Temperature"
  )
# Boxplots for Day, Night, and Difference by City
ggplot(temperature_long_city, aes(x = City, y = Temperature, fill = Temperature_Type)) +
  geom_boxplot(alpha = 0.7, outlier.size = 1) +
  facet_wrap(~ Temperature_Type, scales = "free_y", nrow = 3,
             labeller = labeller(Temperature_Type = c(
               "Average_Day_Temperature" = "Day Temperature",
               "Average_Night_Temperature" = "Night Temperature",
               "Day_Night_Temp_Difference" = "Day-Night Difference"
             ))) +
  labs(
    title = "Temperature Distribution by City",
    x = "City",
    y = "Temperature (℃)"
```

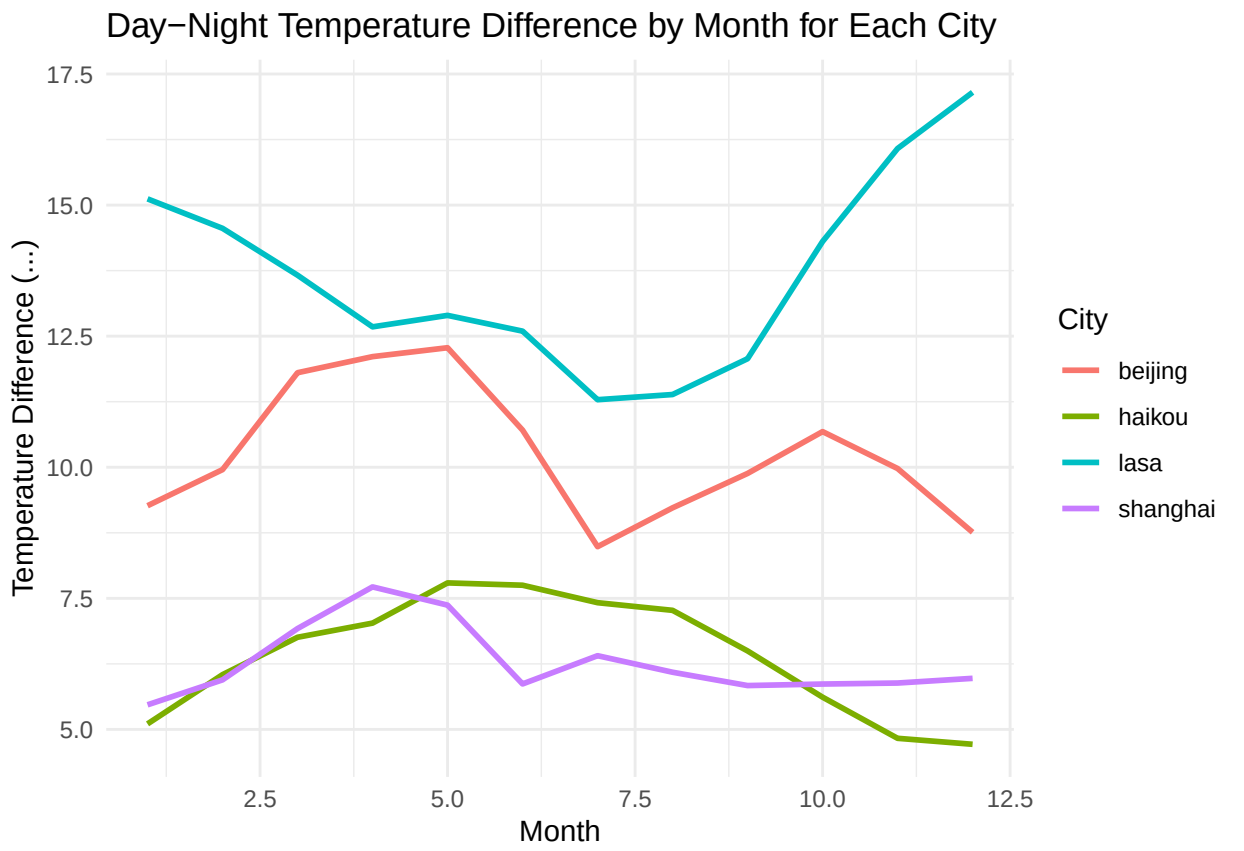
```
  ) +
  theme_minimal() +
  theme(
    legend.position = "none",
    strip.text = element_text(size = 12, face = "bold"),
    axis.text.x = element_text(angle = 45, hjust = 1)
  )
```



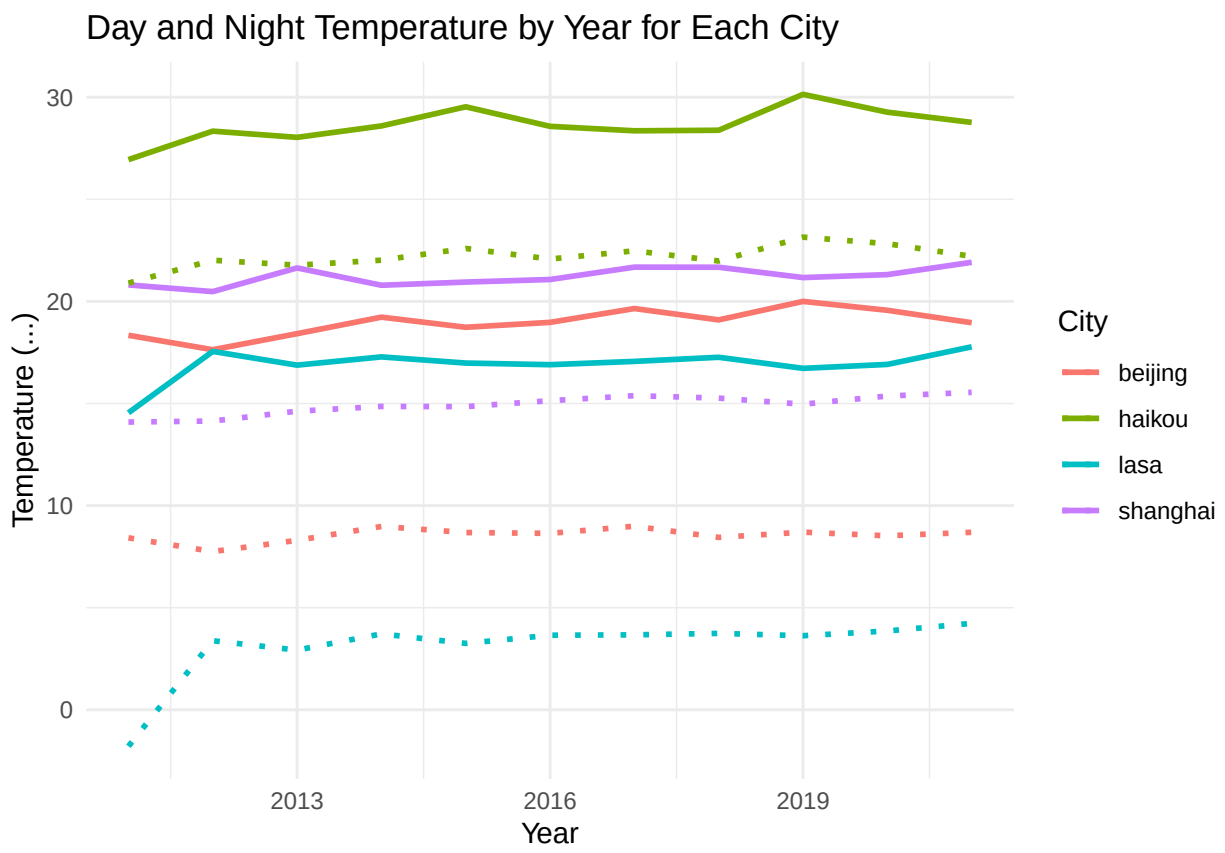

```
# Plot Day and Night Temperature by Month
ggplot(temperature_by_month) +
  geom_line(aes(x = Month, y = Average_Day_Temperature, color = City), linetype = "solid", size = 1) +
  geom_line(aes(x = Month, y = Average_Night_Temperature, color = City), linetype = "dotted", size = 1)
  labs(
    title = "Day and Night Temperature by Month for Each City",
    x = "Month",
    y = "Temperature (℃)",
    color = "City"
  ) +
  theme_minimal()
```



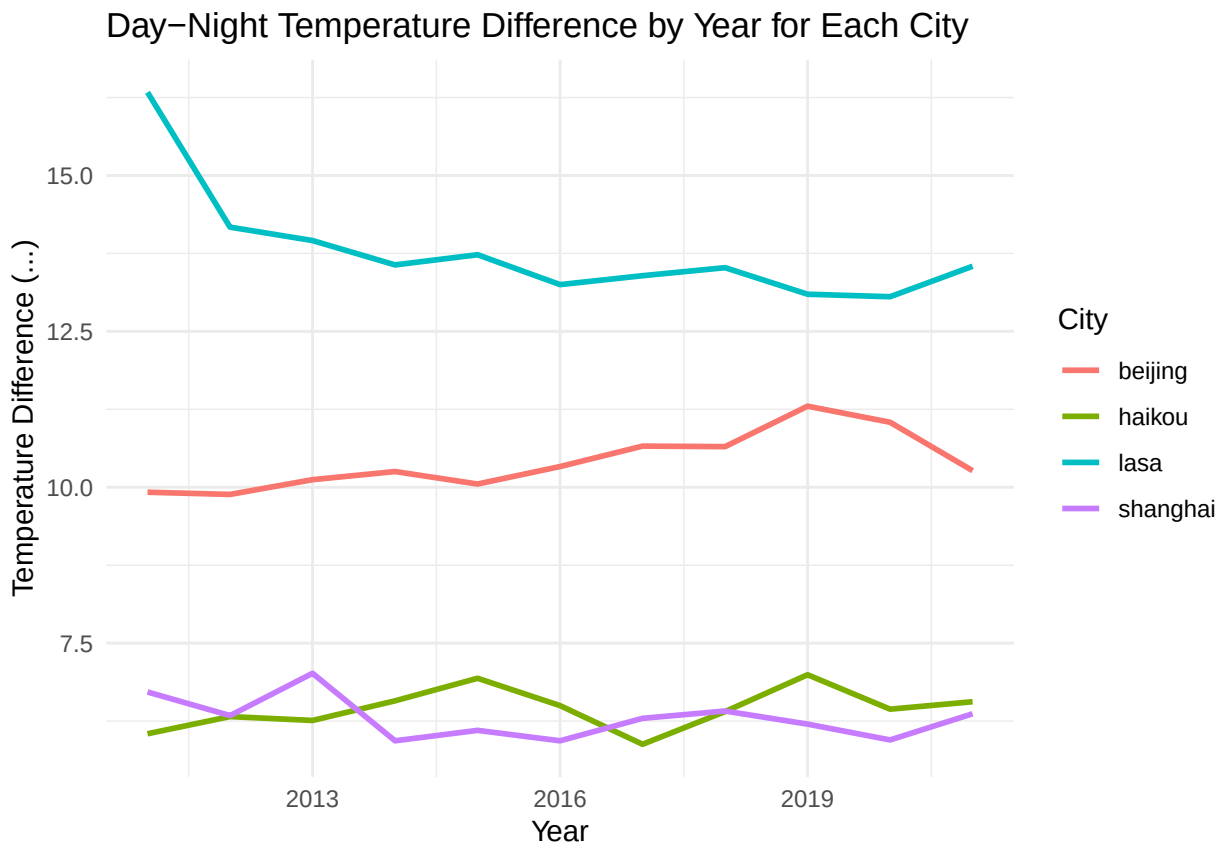

```r
# Plot Day-Night Temperature Difference by Month
ggplot(temperature_by_month, aes(x = Month, y = Day_Night_Temp_Difference, color = City)) +
  geom_line(size = 1) +
  labs(
    title = "Day-Night Temperature Difference by Month for Each City",
    x = "Month",
    y = "Temperature Difference (℃)",
    color = "City"
  ) +
  theme_minimal()
```




```r
# Plot Day and Night Temperature by Year
ggplot(temperature_by_year) +
  geom_line(aes(x = Year, y = Average_Day_Temperature, color = City), linetype = "solid", size = 1) +
  geom_line(aes(x = Year, y = Average_Night_Temperature, color = City), linetype = "dotted", size = 1) +
  labs(
    title = "Day and Night Temperature by Year for Each City",
    x = "Year",
    y = "Temperature (℃)",
    color = "City"
  ) +
  theme_minimal()
```

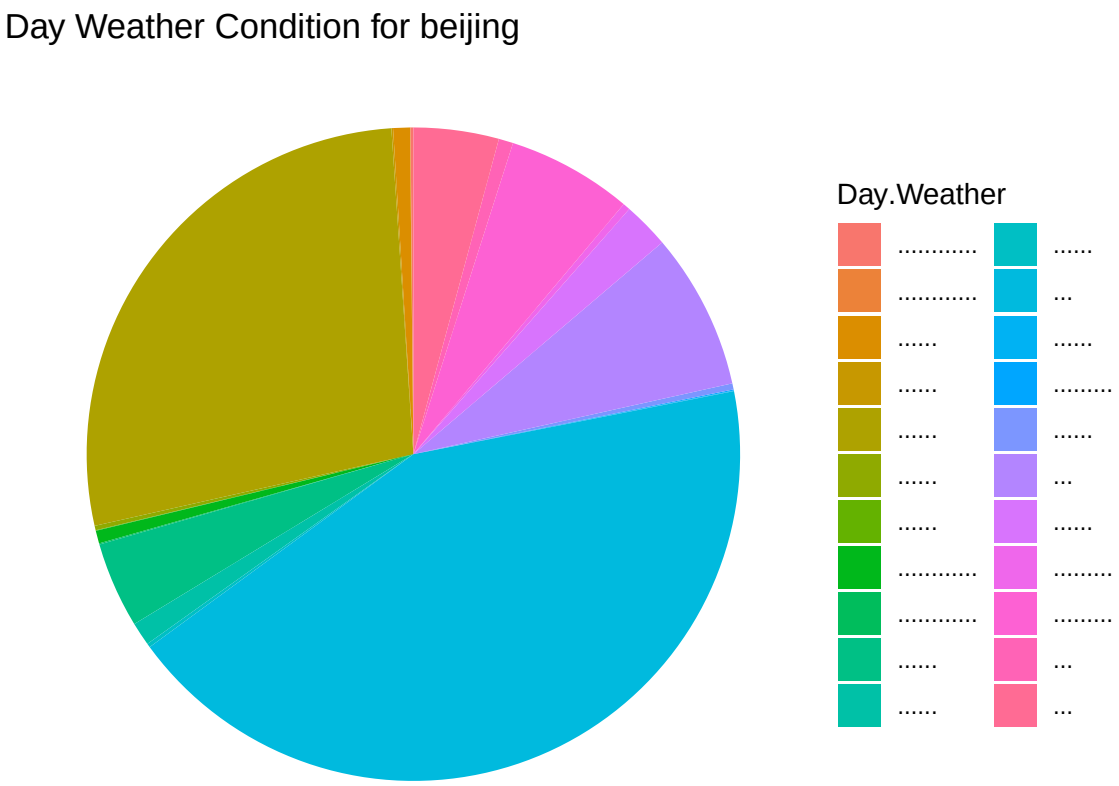



```r
# Plot Day-Night Temperature Difference by Year
ggplot(temperature_by_year, aes(x = Year, y = Day_Night_Temp_Difference, color = City)) +
  geom_line(size = 1) +
  labs(
    title = "Day-Night Temperature Difference by Year for Each City",
    x = "Year",
    y = "Temperature Difference (℃)",
    color = "City"
  ) +
  theme_minimal()
```

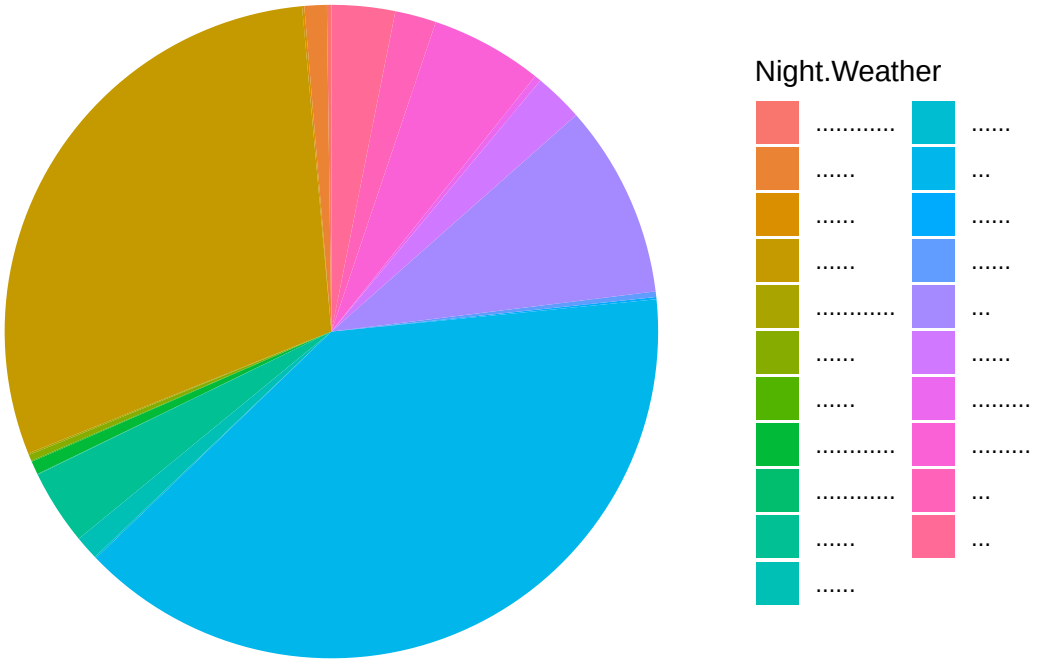


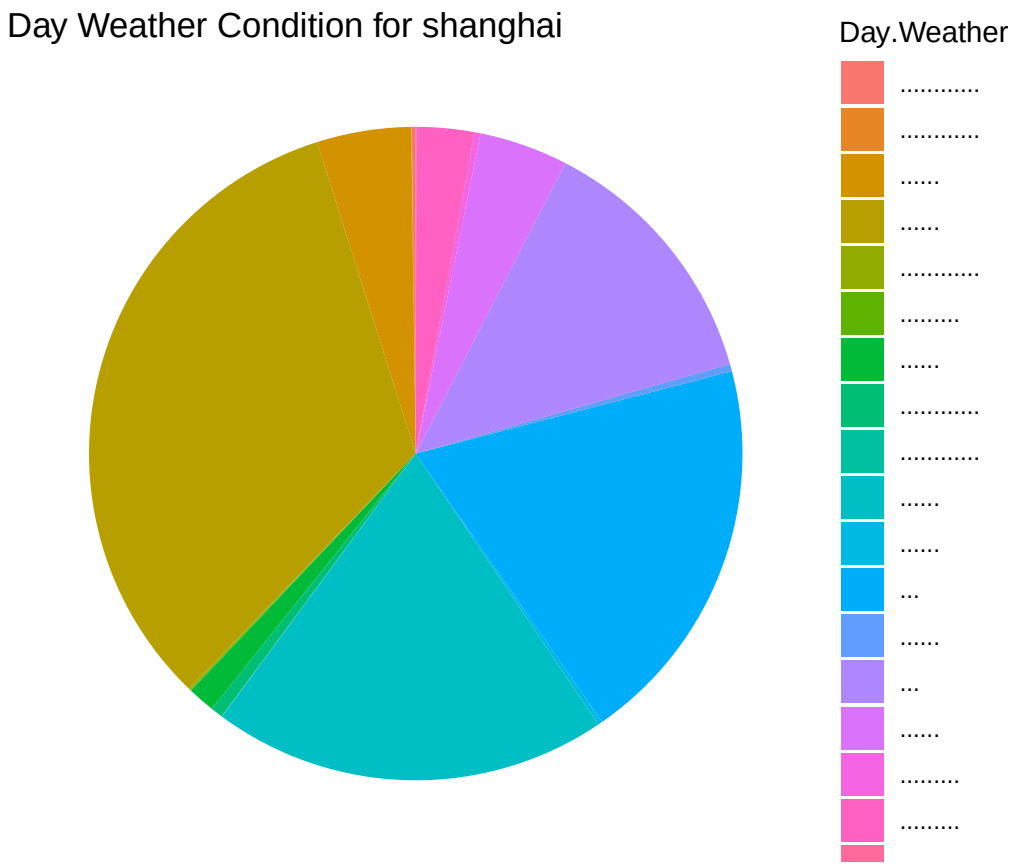

```r
day_weather_counts <- data %>%
  group_by(City, Day.Weather) %>%
  tally() %>%
  ungroup()

night_weather_counts <- data %>%
  group_by(City, Night.Weather) %>%
  tally() %>%
  ungroup()


# Function to plot pie chart for weather conditions by city
plot_pie_chart <- function(data, city, weather_column, title) {
  city_data <- data %>% filter(City == city)
  p <- ggplot(city_data, aes(x = "", y = n, fill = !!sym(weather_column))) +
    geom_bar(stat = "identity", width = 1) +
    coord_polar(theta = "y") +
    labs(title = paste(title, "for", city), fill = weather_column) +
    theme_void()
  return(p)
}

# Example: Plot pie chart for the first city in the dataset (you can loop for all cities)
cities <- unique(data$City)

# Create a list of plots for all cities
```

```r
plots <- list()

# Loop through cities to plot pie charts for Day and Night weather conditions

for (city in cities) {
  # Day Weather Pie Chart
  day_plot <- plot_pie_chart(day_weather_counts, city, "Day.Weather", "Day Weather Condition")
  print(day_plot)

  # Night Weather Pie Chart
  night_plot <- plot_pie_chart(night_weather_counts, city, "Night.Weather", "Night Weather Condition")
  print(night_plot)
}
```



Night Weather Condition for beijing




Day Weather Condition for shanghai
Day.Weather
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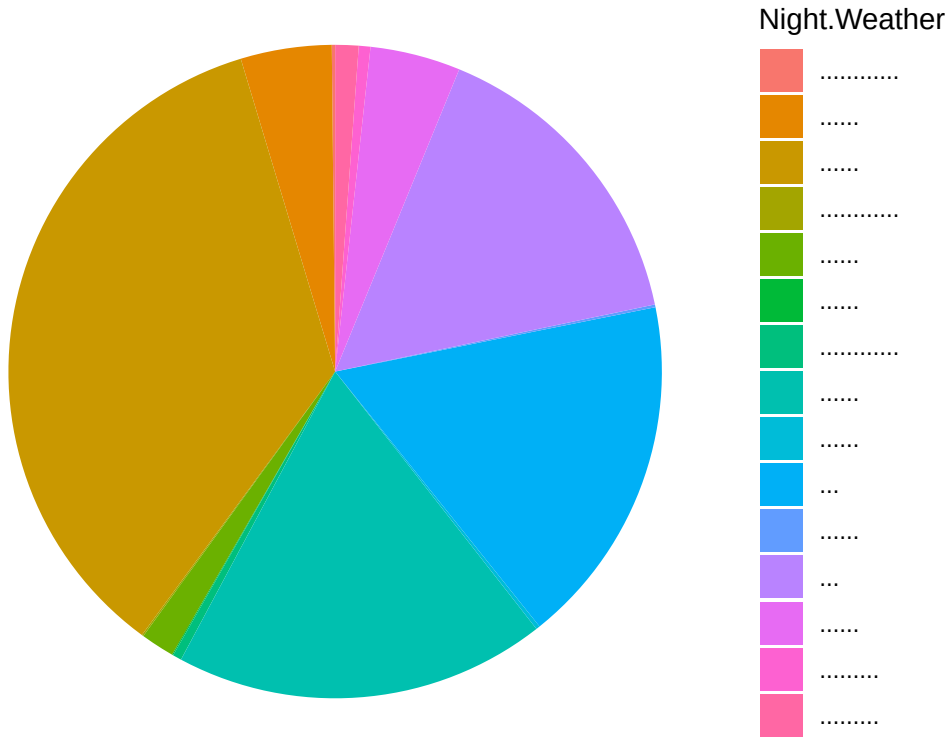
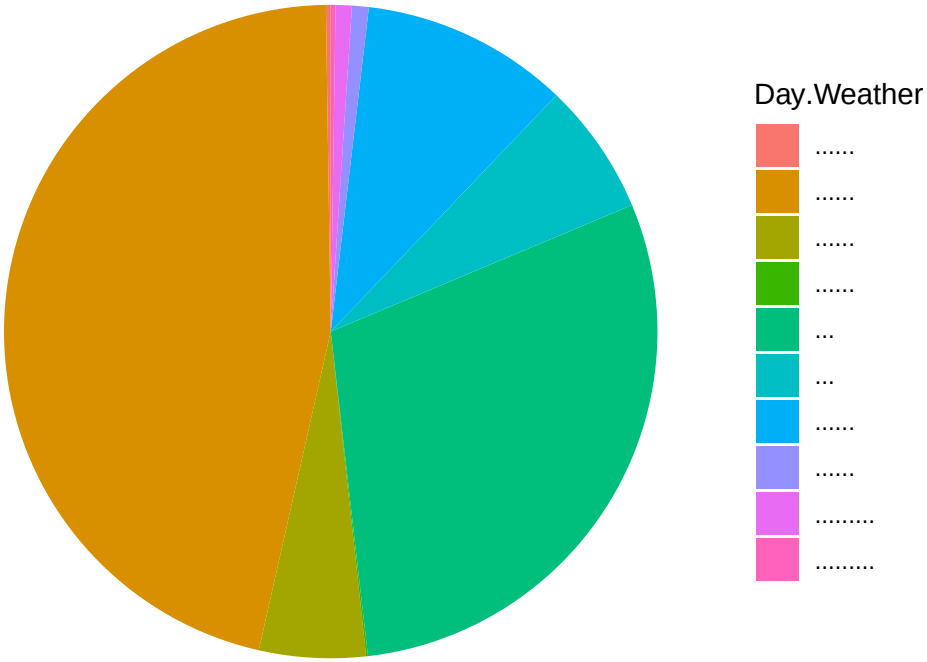
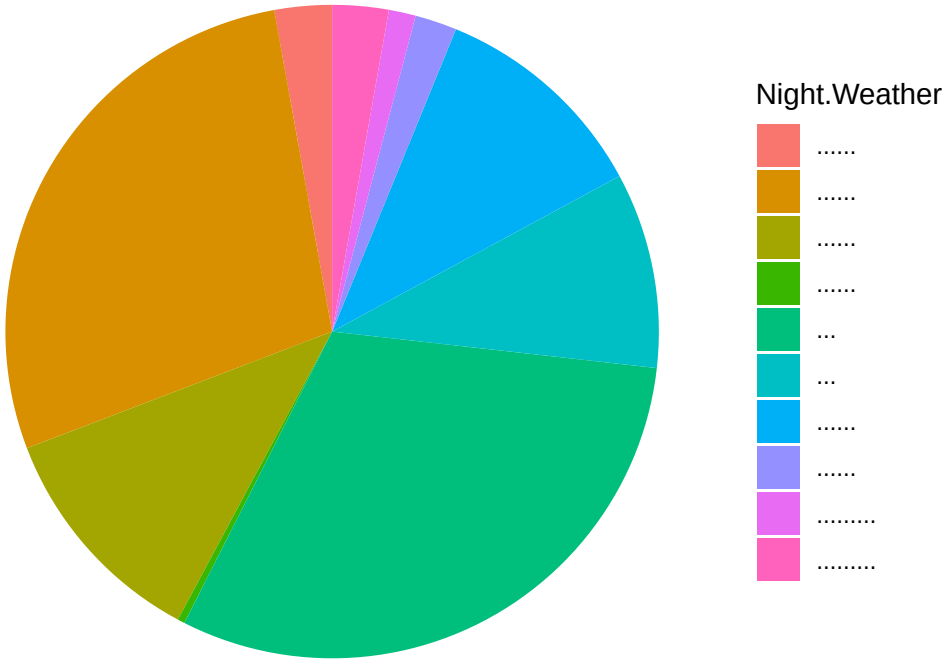
Night Weather Condition for shanghai



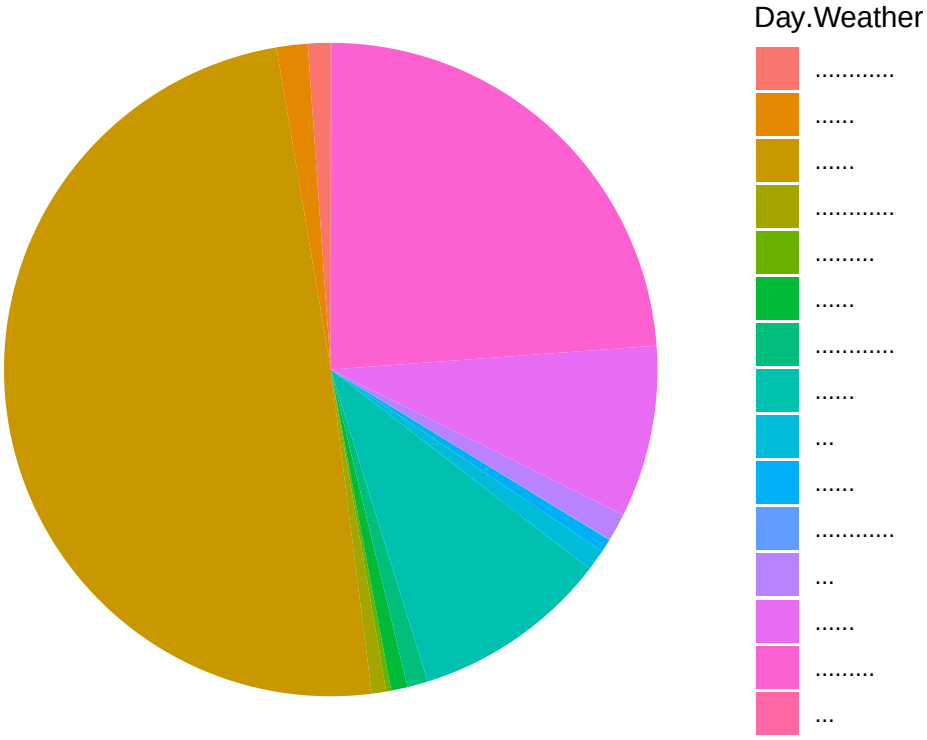
Day Weather Condition for lasa

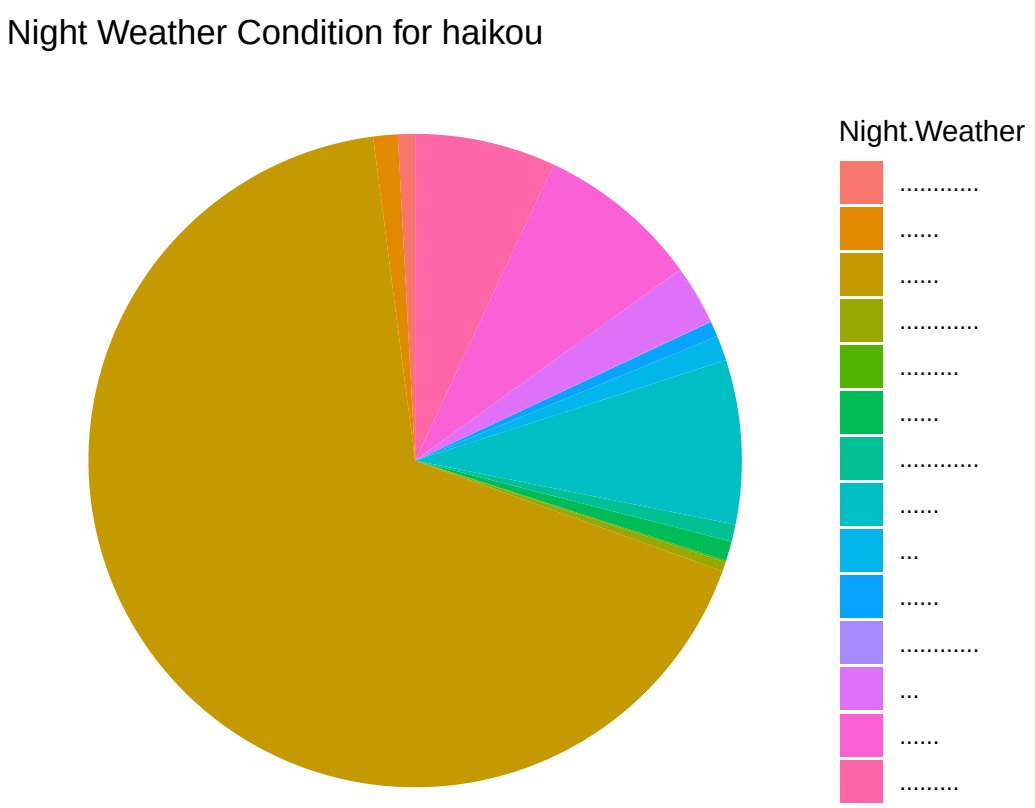


Night Weather Condition for lasa

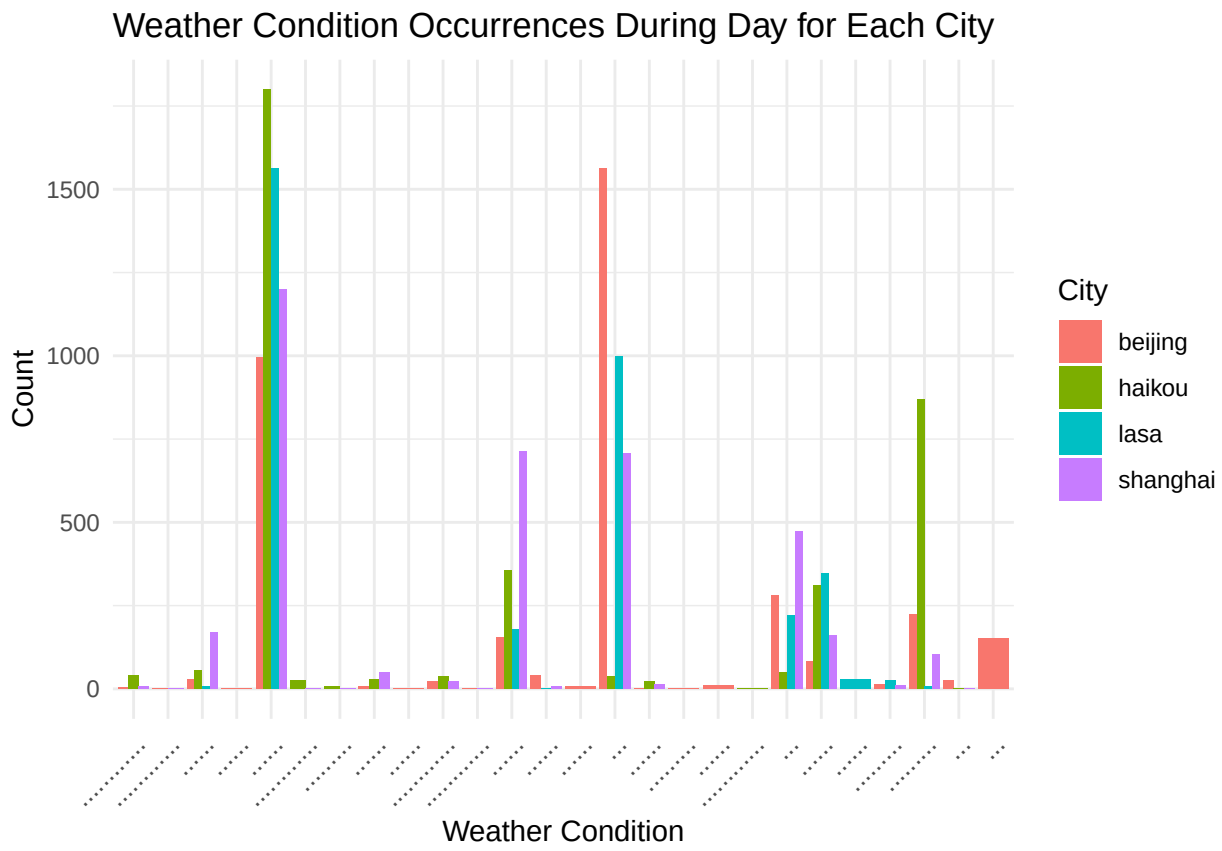


Day Weather Condition for haikou

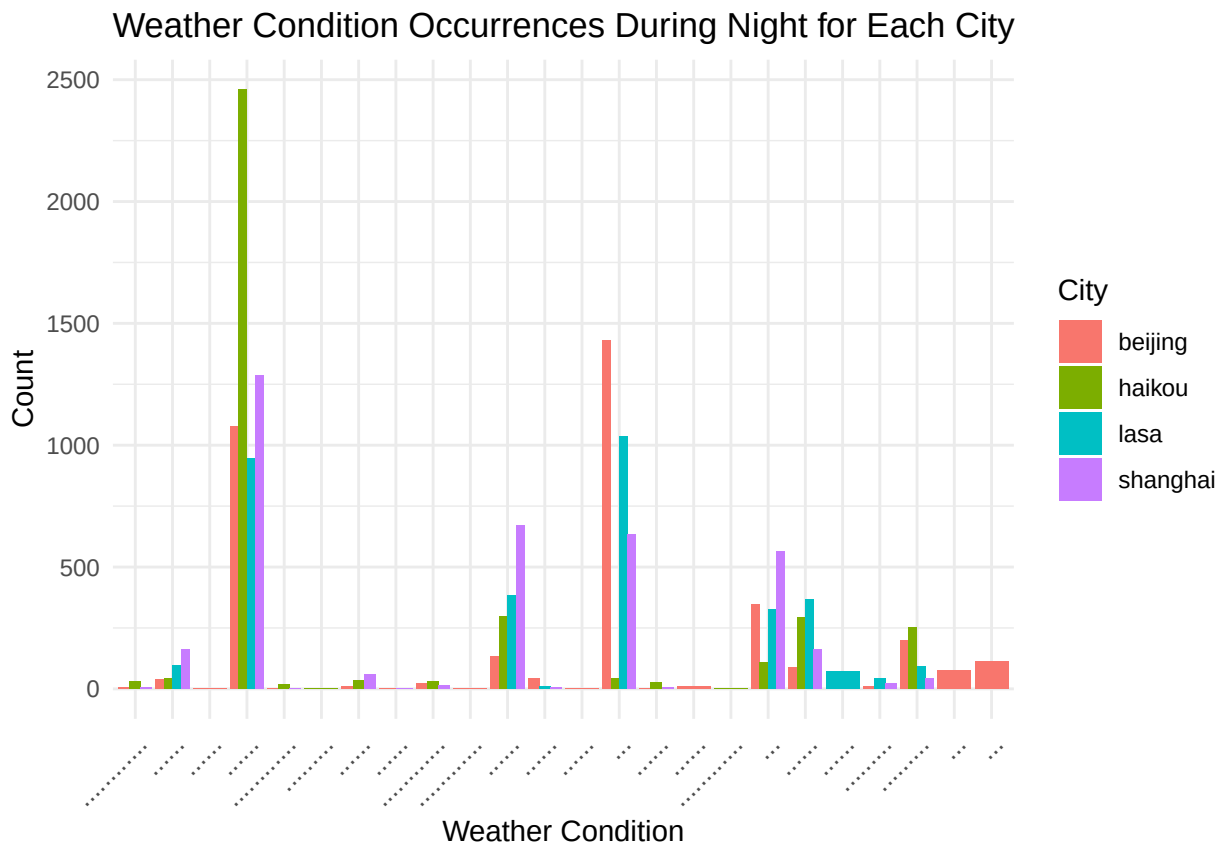





```
# Count the occurrences of each weather condition (Day and Night) by city
weather_condition_day <- data %>%
  group_by(City, Day.Weather) %>%
  summarise(Count = n())

weather_condition_night <- data %>%
  group_by(City, Night.Weather) %>%
  summarise(Count = n())

# Plot weather condition occurrences (day)
ggplot(weather_condition_day, aes(x = Day.Weather, y = Count, fill = City)) +
  geom_bar(stat = "identity", position = "dodge") +
  labs(title = "Weather Condition Occurrences During Day for Each City", x = "Weather Condition", y = "
  theme_minimal()+
  theme(
    axis.text.x = element_text(angle = 45, hjust = 1, size = 10) # Rotate labels by 45 degrees
  )
```

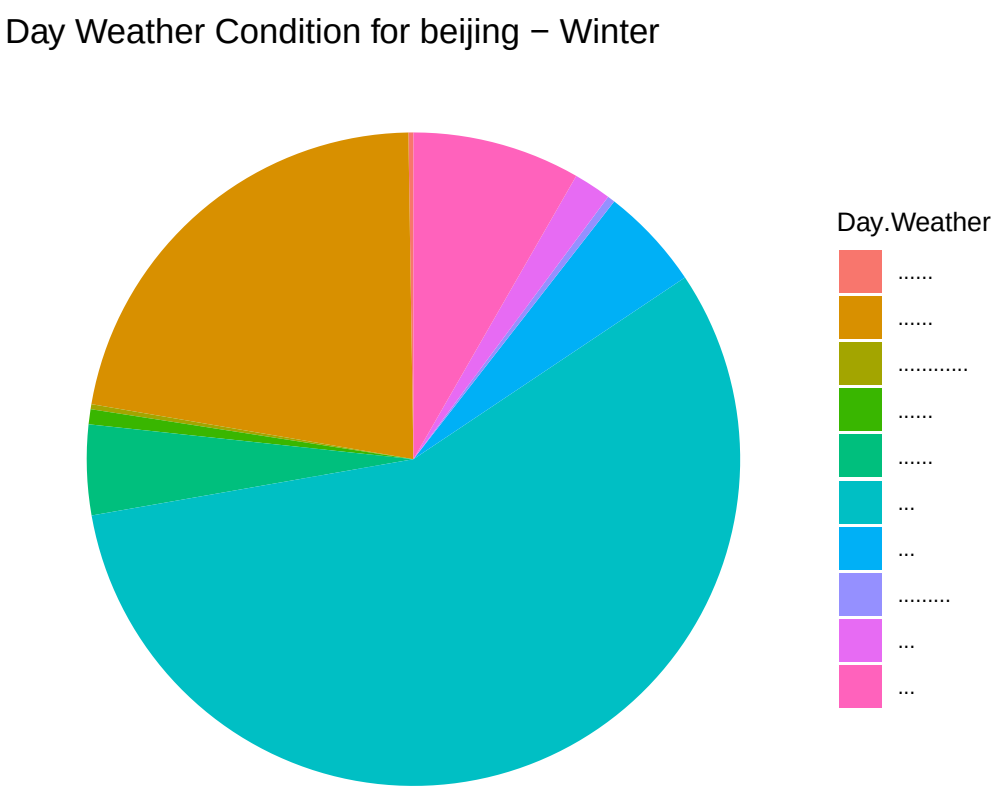


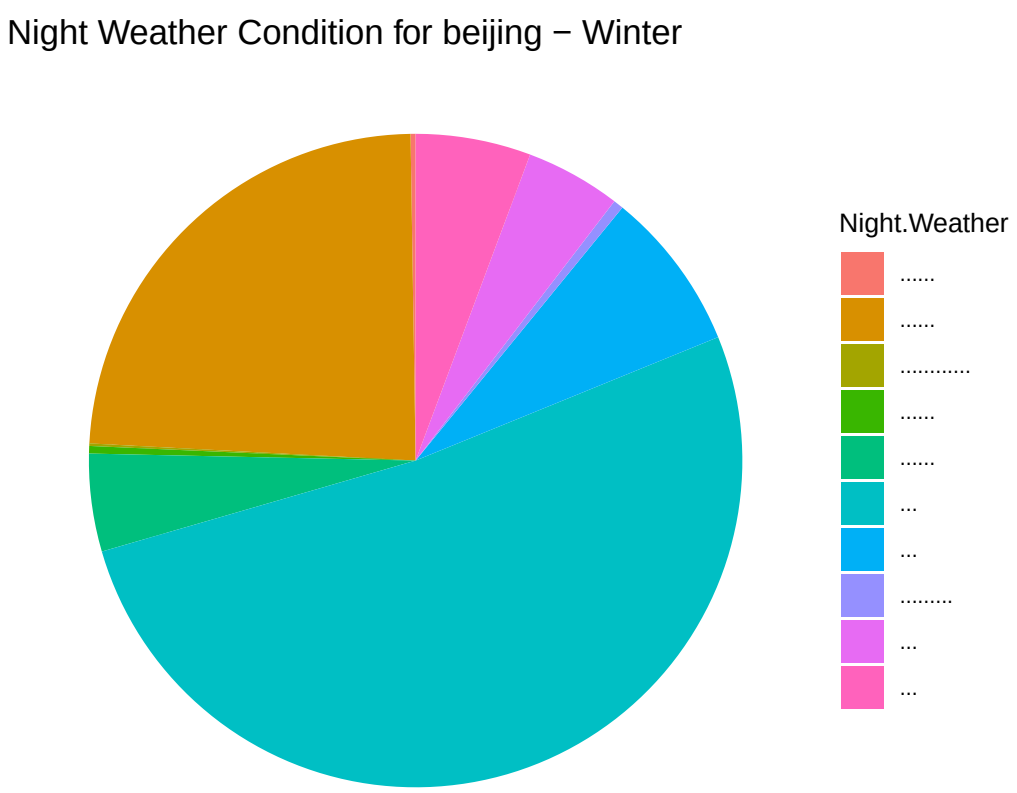

```
ggplot(weather_condition_night, aes(x = Night.Weather, y = Count, fill = City)) +
  geom_bar(stat = "identity", position = "dodge") +
  labs(title = "Weather Condition Occurrences During Night for Each City", x = "Weather Condition", y =
  theme_minimal() +
  theme(
    axis.text.x = element_text(angle = 45, hjust = 1, size = 10) # Rotate labels by 45 degrees
  )
```




```
day_weather_counts <- data %>%
  group_by(City, Season, Day.Weather) %>%
  tally() %>%
  ungroup()

night_weather_counts <- data %>%
  group_by(City, Season, Night.Weather) %>%
  tally() %>%
  ungroup()

# Function to plot pie chart for weather conditions by city and season
plot_pie_chart <- function(data, city, season, weather_column, title) {
  city_season_data <- data %>% filter(City == city & Season == season)
  p <- ggplot(city_season_data, aes(x = "", y = n, fill = !!sym(weather_column))) +
    geom_bar(stat = "identity", width = 1) +
    coord_polar(theta = "y") +
    labs(title = paste(title, "for", city, "-", season), fill = weather_column) +
    theme_void() +
    theme(legend.position = "right",  # Move legend outside the plot
          legend.title = element_text(size = 10), # Adjust the legend title size
          legend.text = element_text(size = 8))   # Adjust the legend text size
  return(p)
}

# Loop through cities and seasons to plot pie charts for Day and Night weather conditions
cities <- unique(data$City)
```

```r
seasons <- unique(data$Season)

for (city in cities) {
  for (season in seasons) {
    # Day Weather Pie Chart
    day_plot <- plot_pie_chart(day_weather_counts, city, season, "Day.Weather", "Day Weather Condition")
    print(day_plot)

    # Night Weather Pie Chart
    night_plot <- plot_pie_chart(night_weather_counts, city, season, "Night.Weather", "Night Weather Co
    print(night_plot)
  }
}
```




Night Weather Condition for beijing − Winter
Night.Weather
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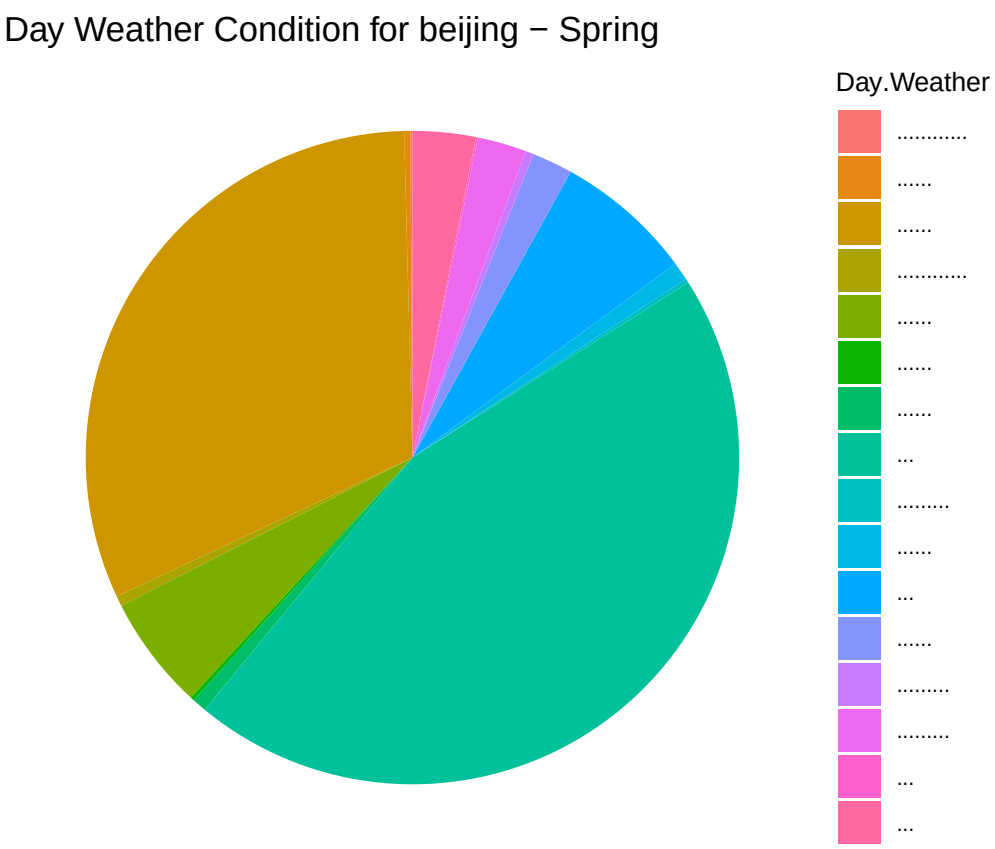
Day Weather Condition for beijing − Spring
Day.Weather
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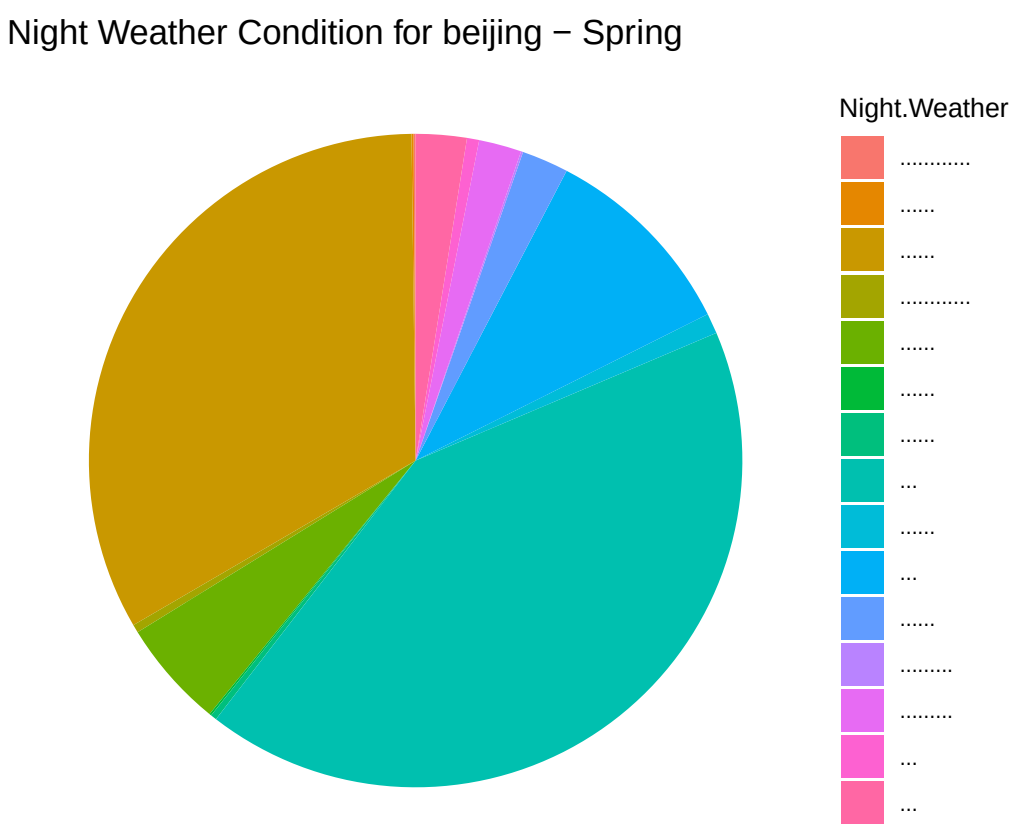
Night Weather Condition for beijing − Spring
Night.Weather
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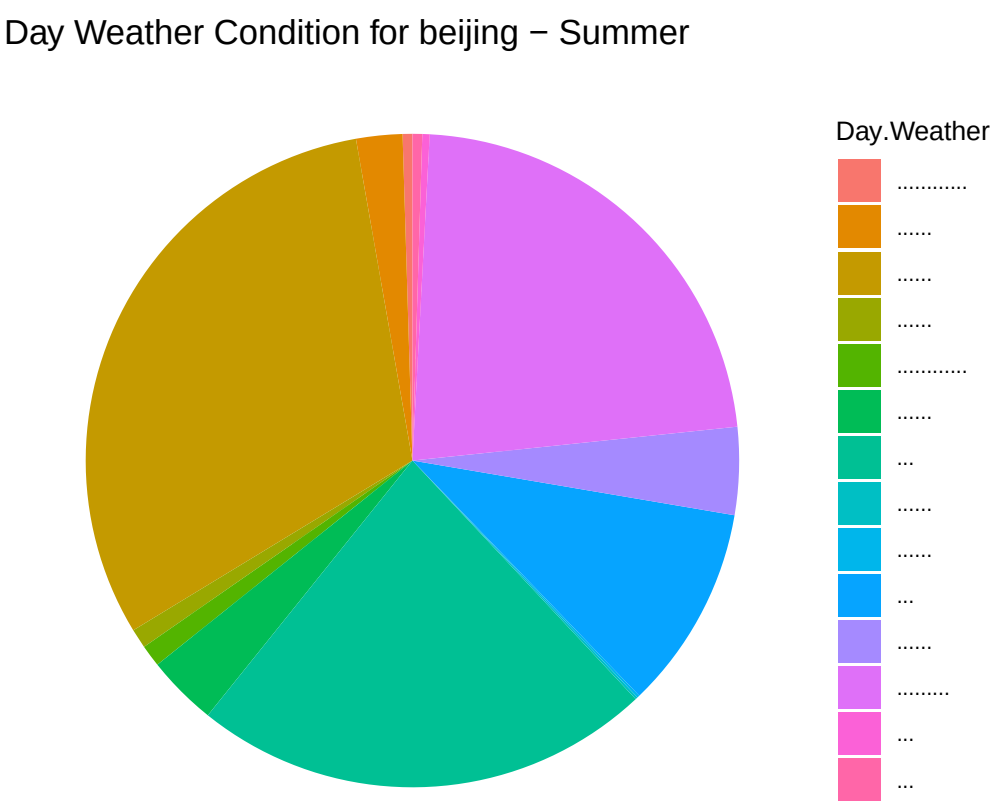
Day Weather Condition for beijing − Summer
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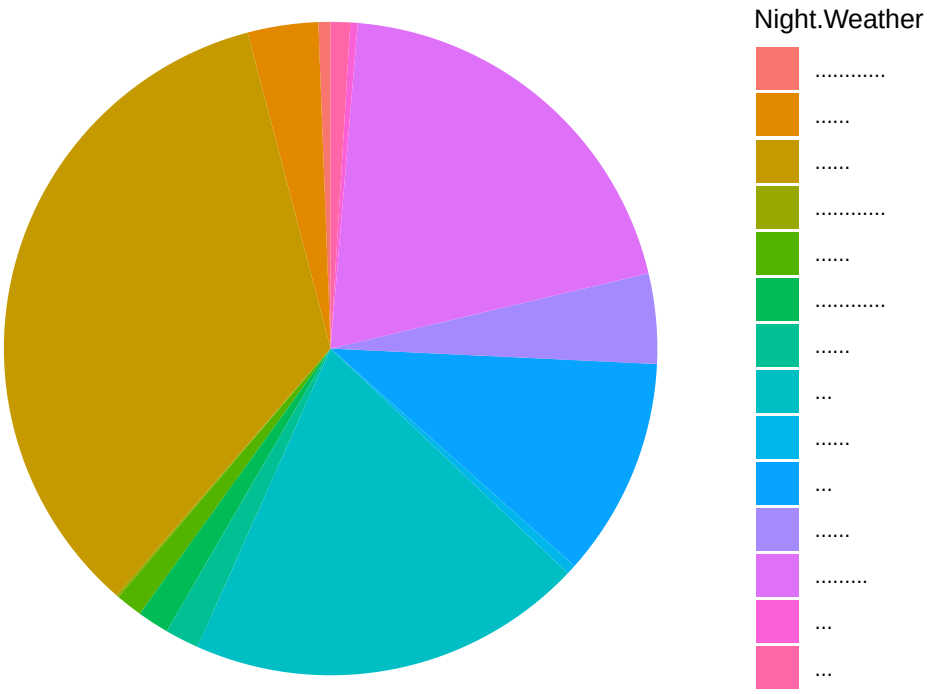
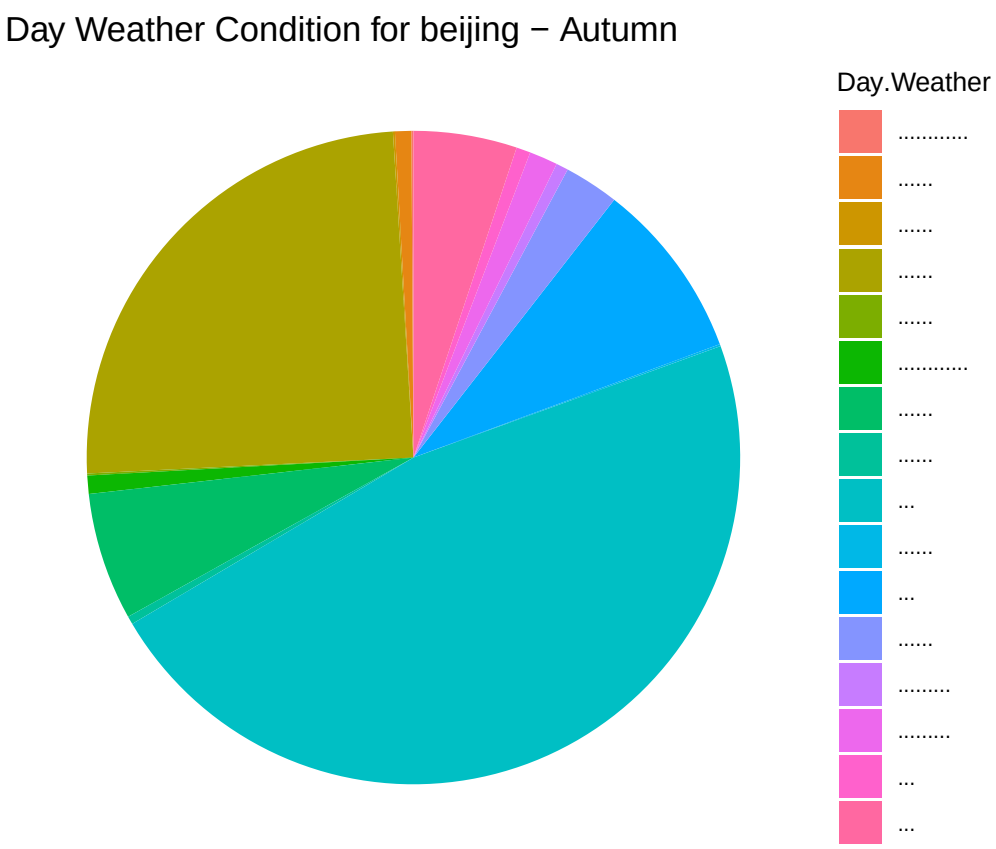
Night Weather Condition for beijing − Summer




Day Weather Condition for beijing − Autumn
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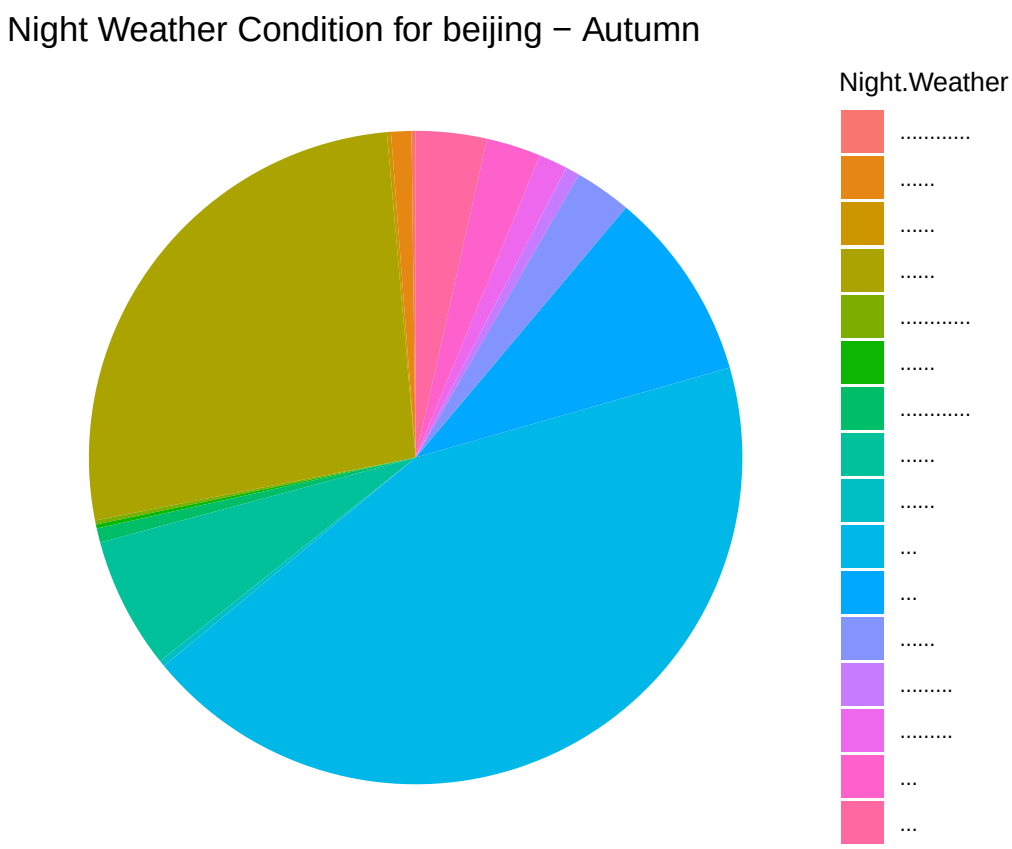
Night Weather Condition for beijing − Autumn
Night.Weather
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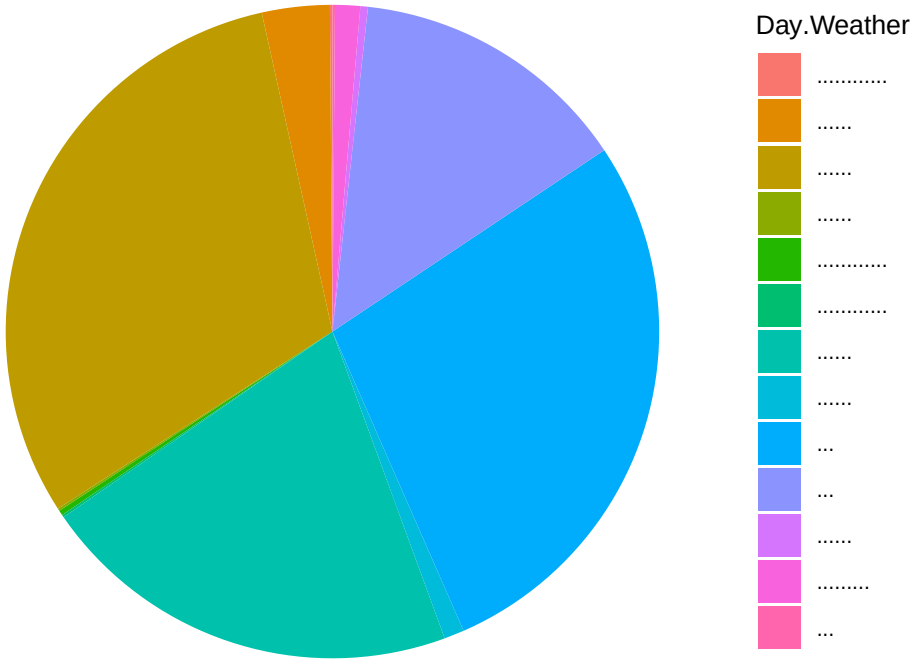
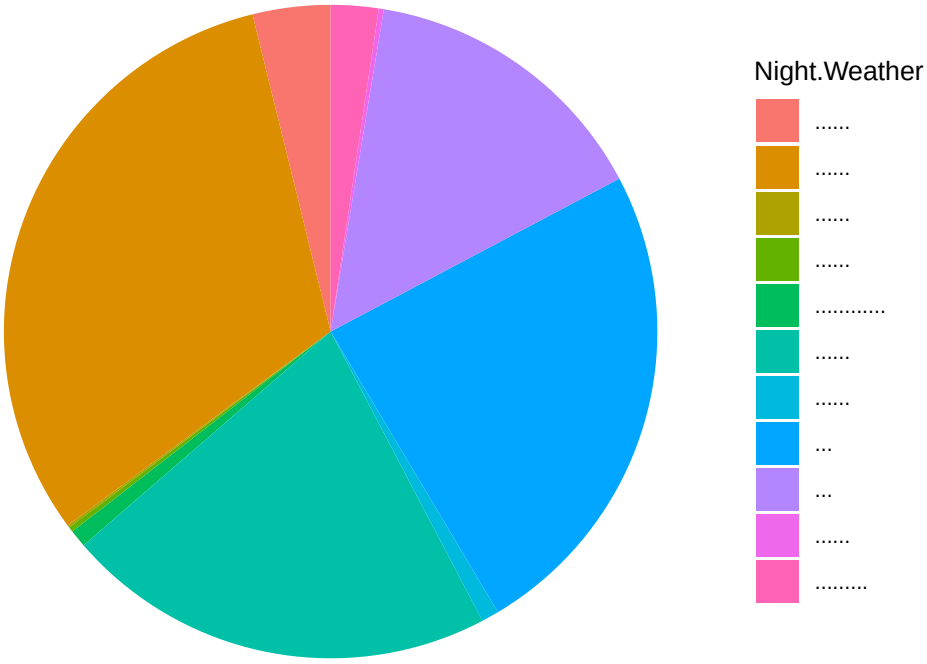
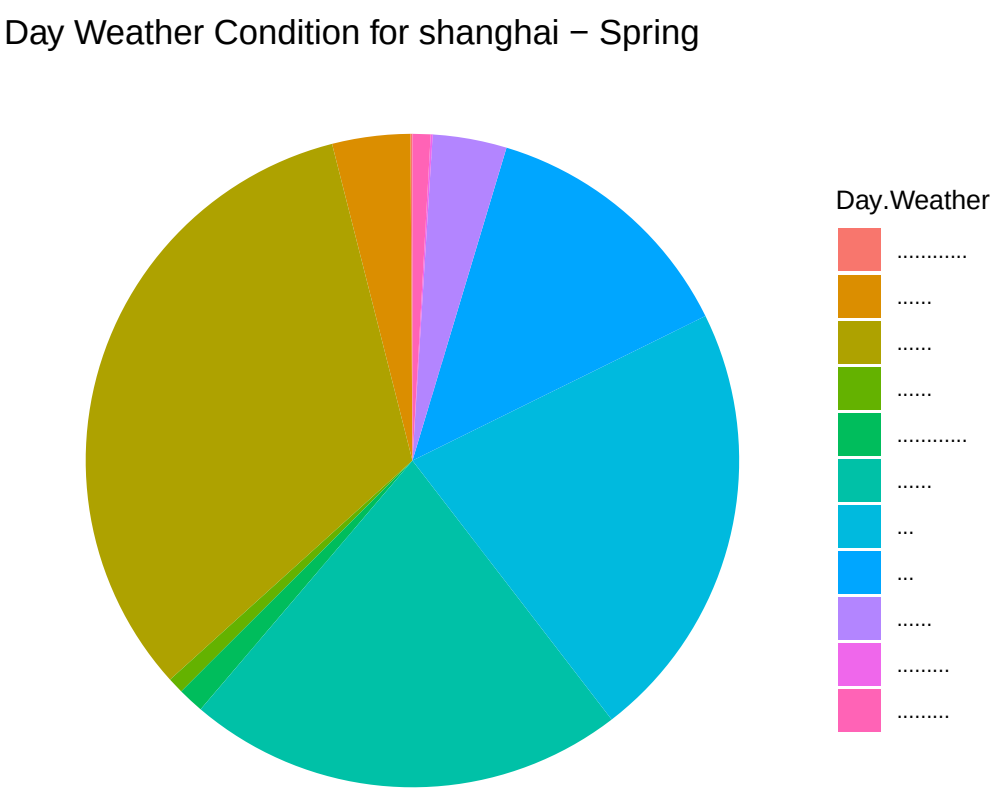
Day Weather Condition for shanghai − Winter



Night Weather Condition for shanghai − Winter




Day Weather Condition for shanghai − Spring
Day.Weather
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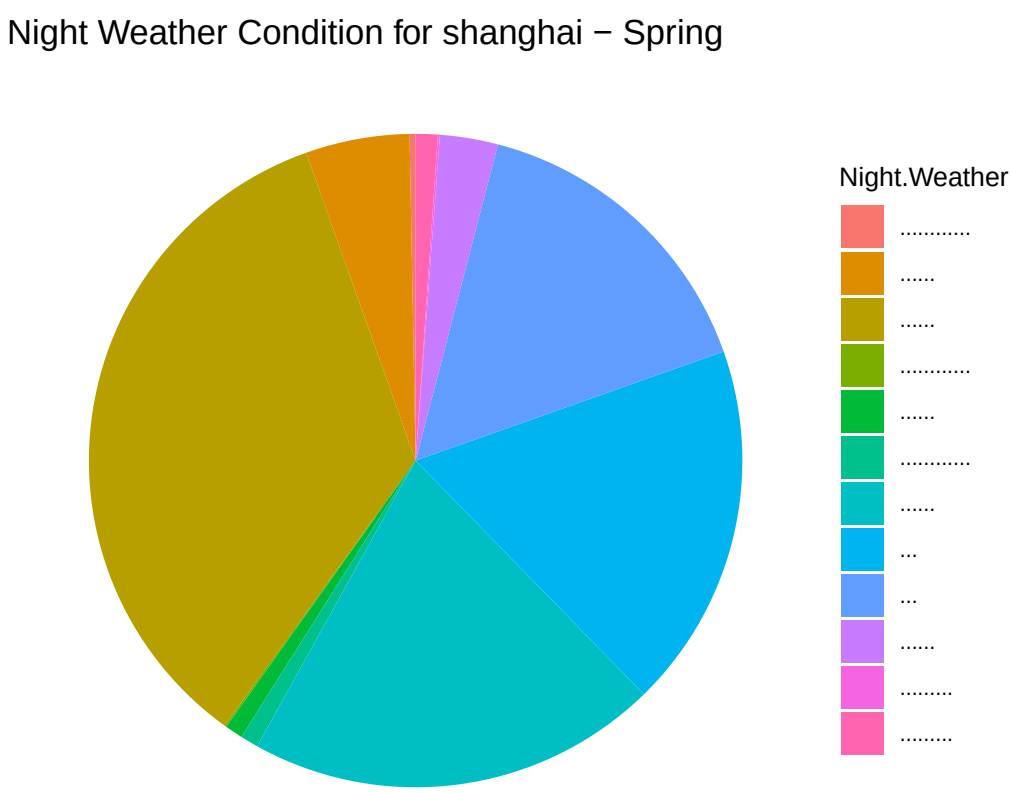
Night Weather Condition for shanghai − Spring
Night.Weather
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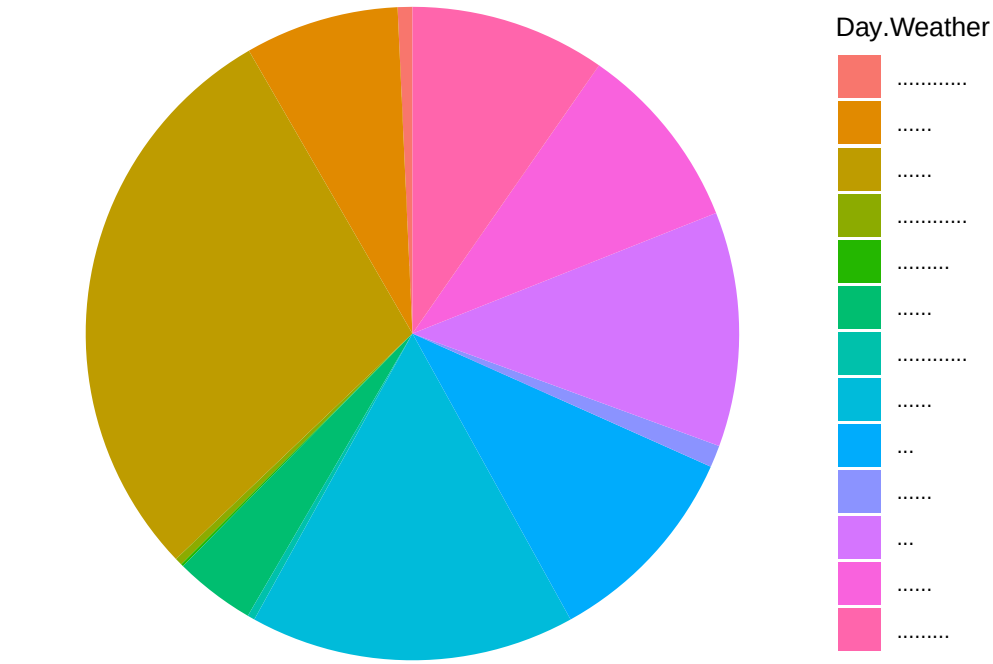
Day Weather Condition for shanghai − Summer
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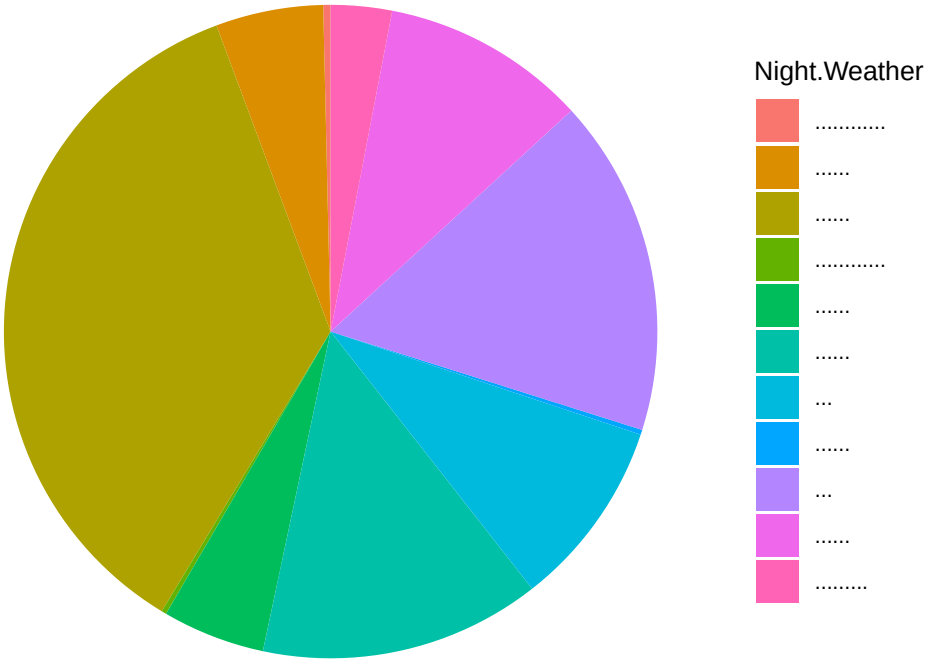
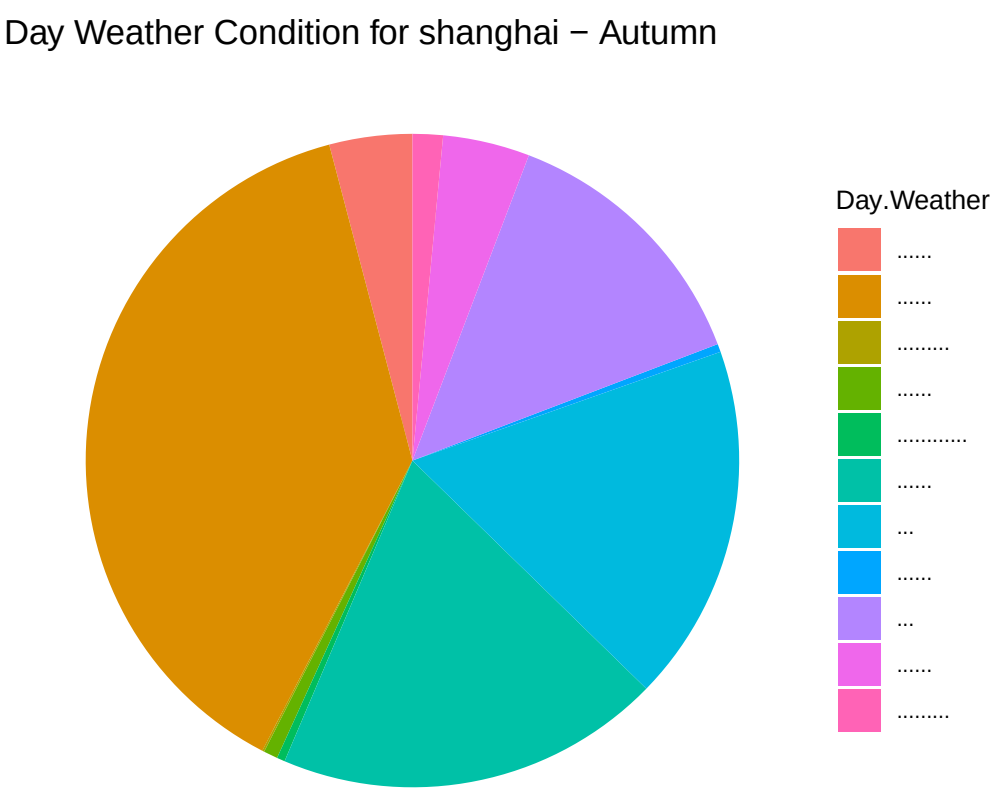
Night Weather Condition for shanghai − Summer




Day Weather Condition for shanghai − Autumn
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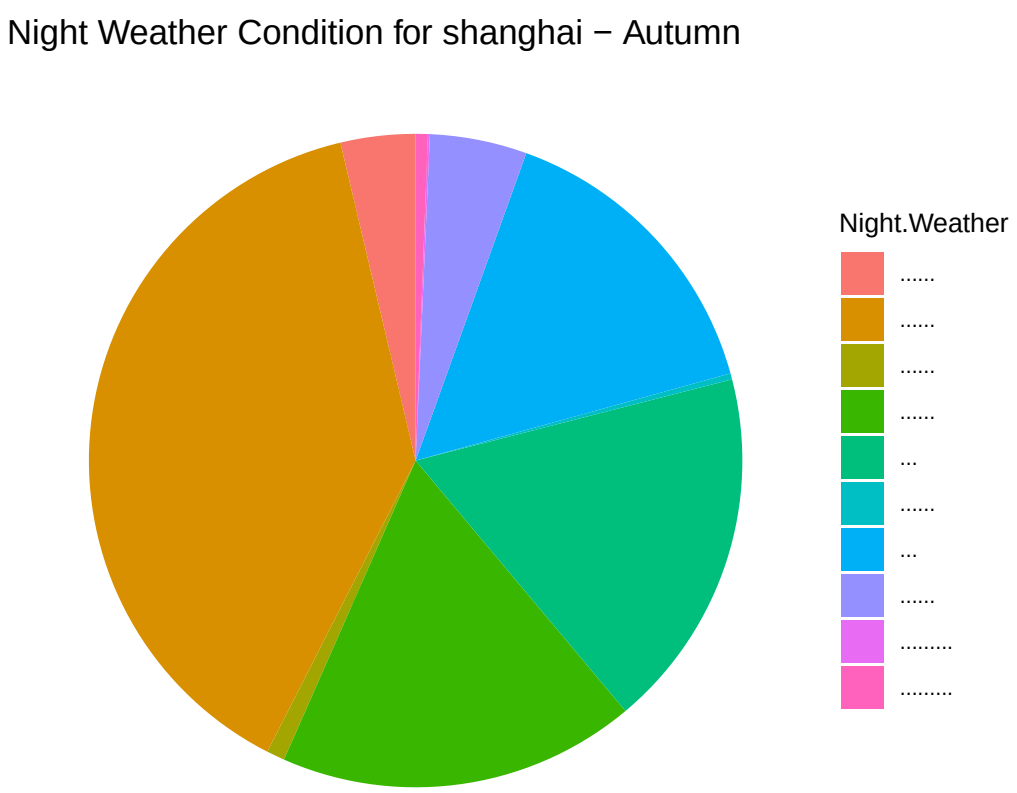
Night Weather Condition for shanghai − Autumn
Night.Weather
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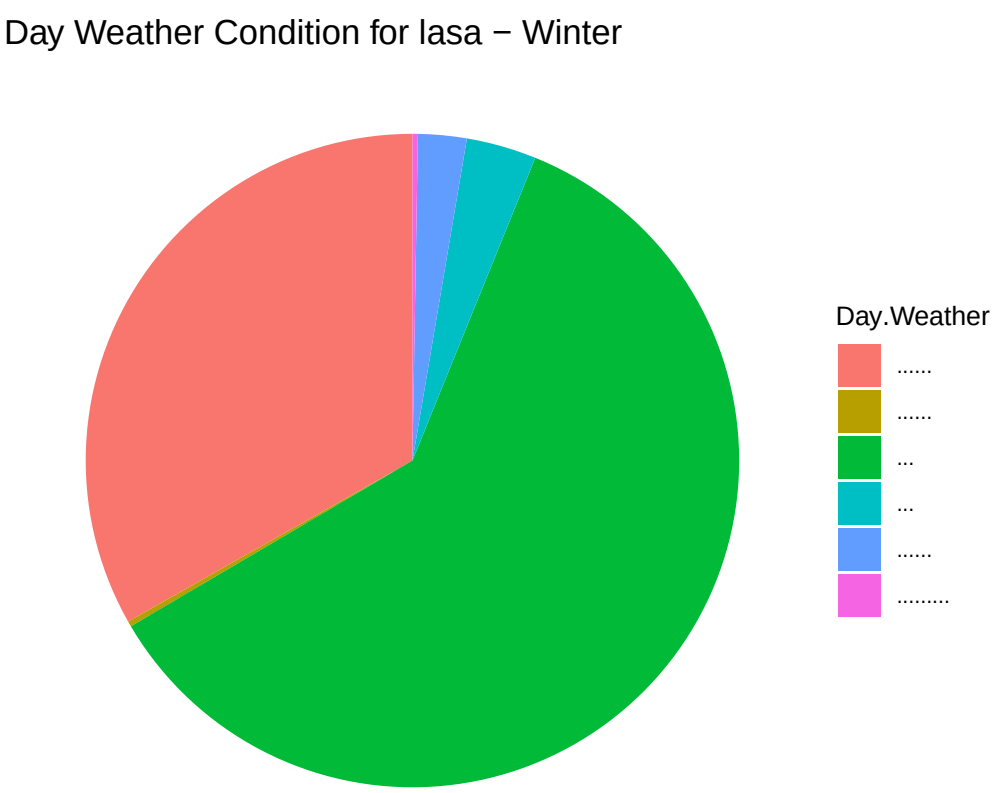
Day Weather Condition for lasa − Winter
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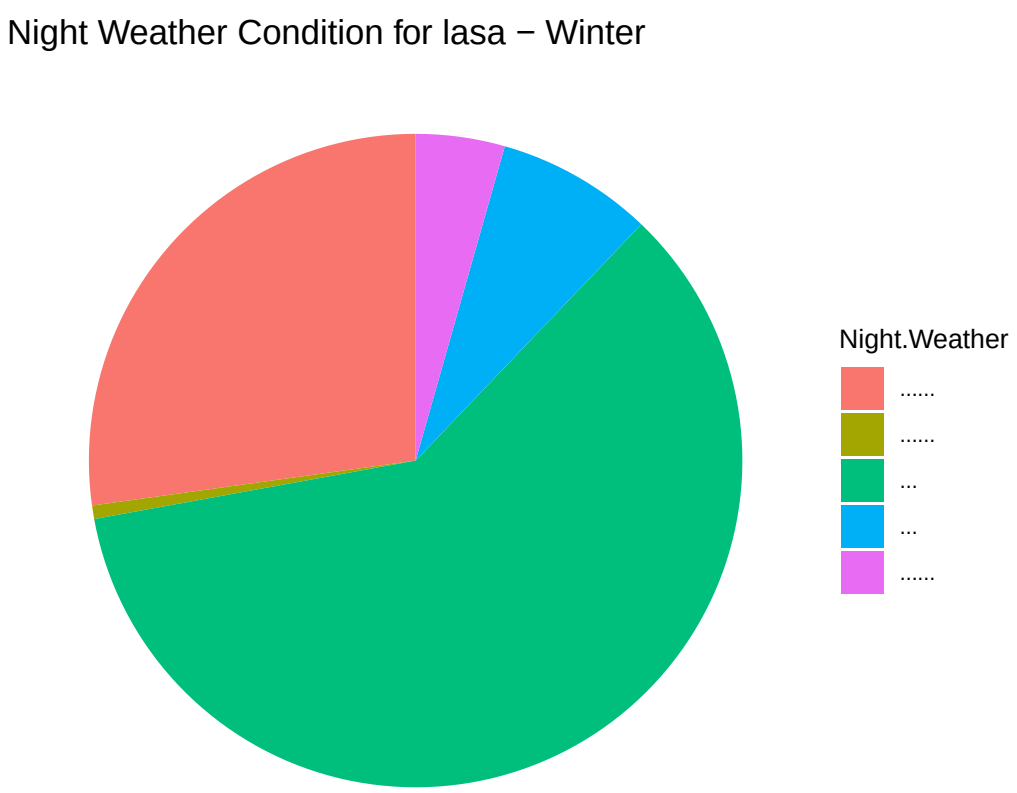
Night Weather Condition for lasa − Winter
Night.Weather
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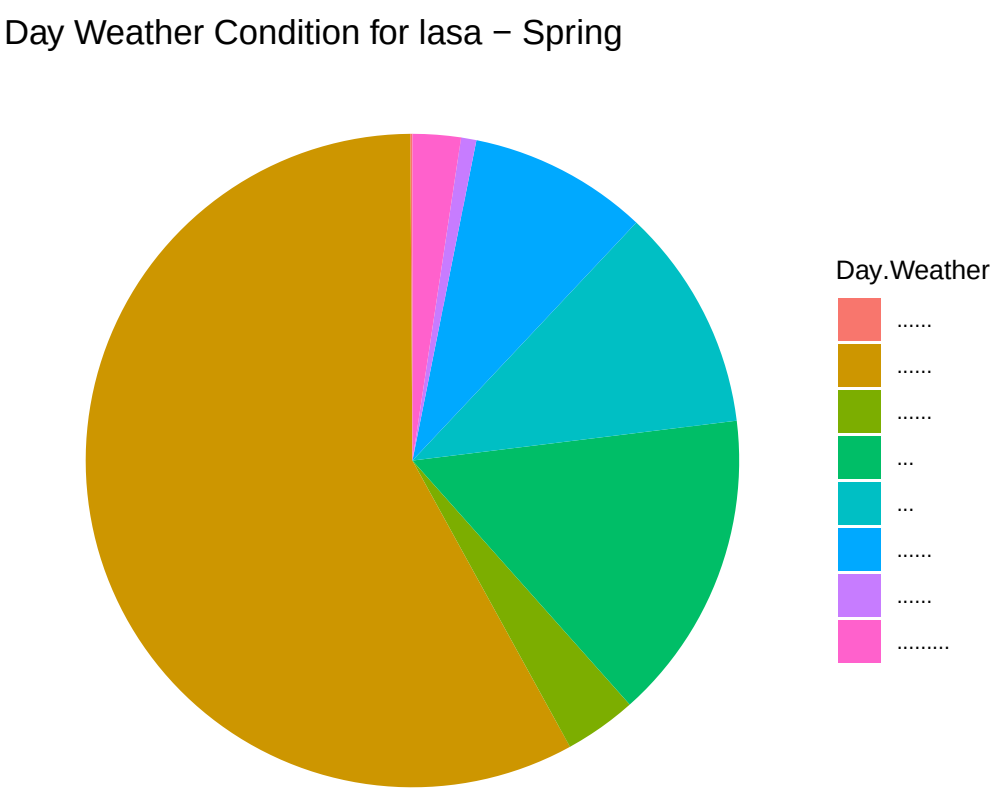
Day Weather Condition for lasa − Spring
Day.Weather
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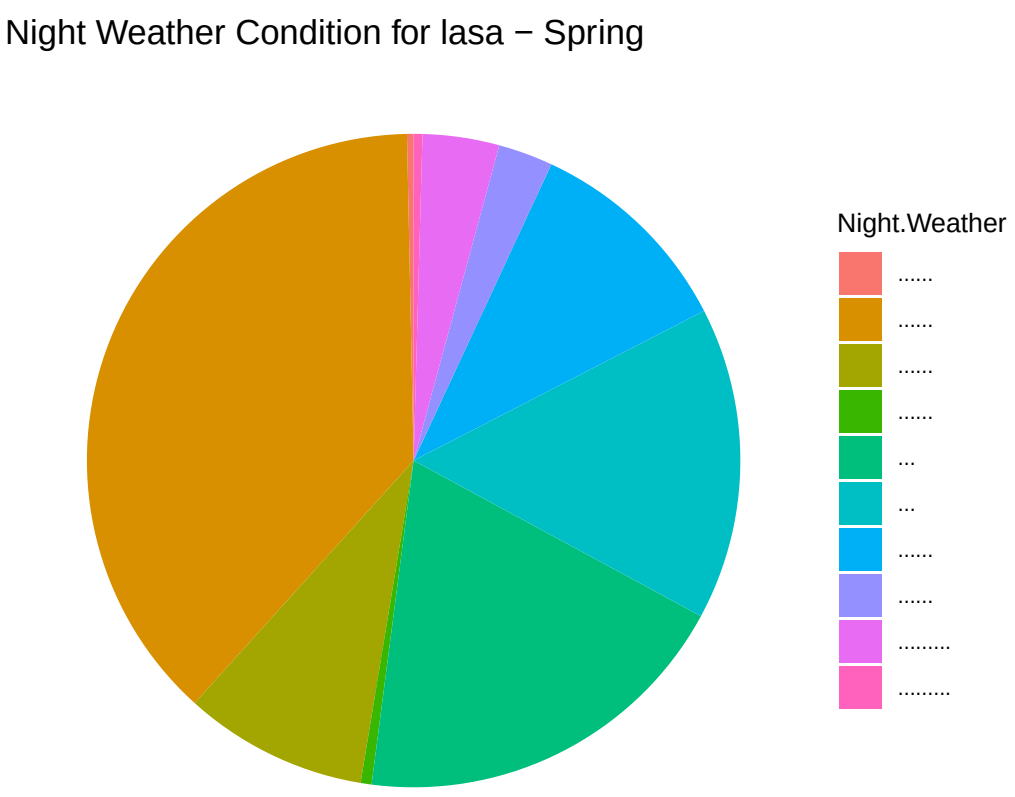
Night Weather Condition for lasa − Spring
Night.Weather
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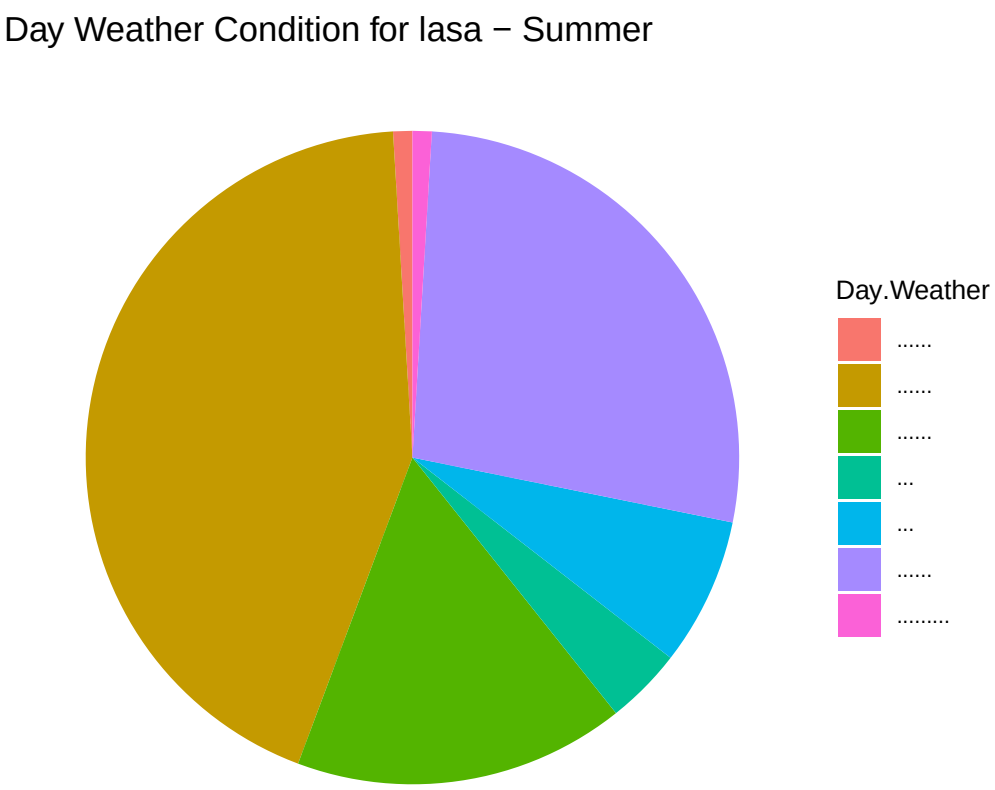
Day Weather Condition for lasa − Summer
Day.Weather
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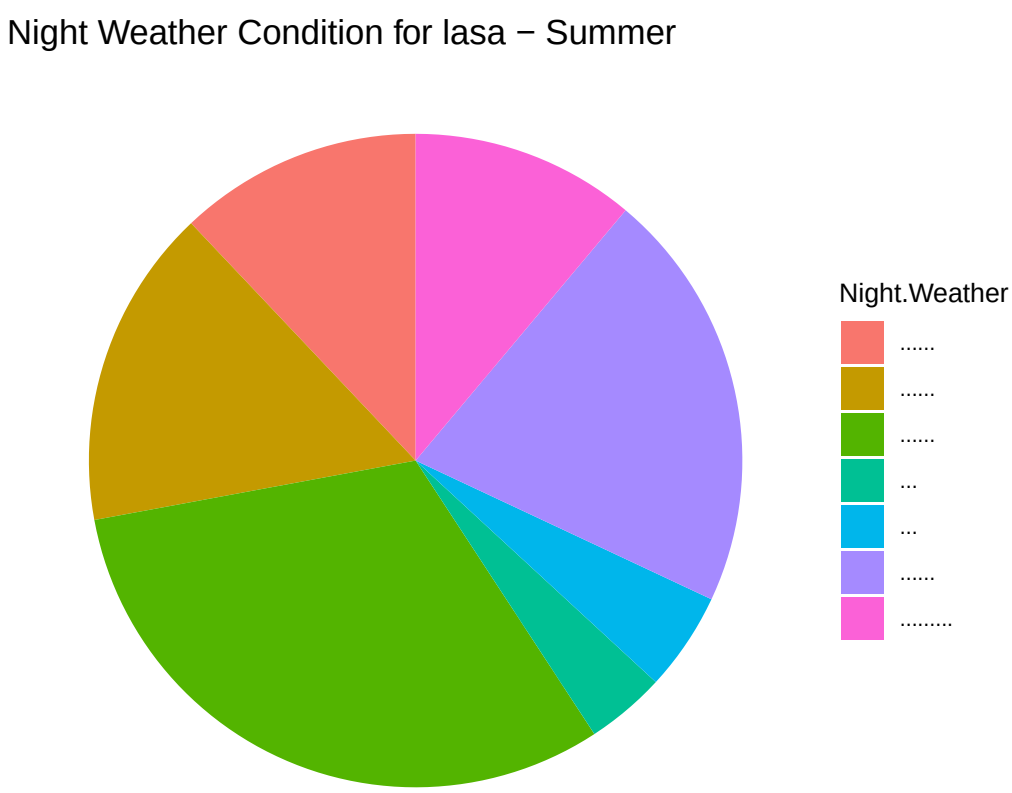
Night Weather Condition for lasa − Summer
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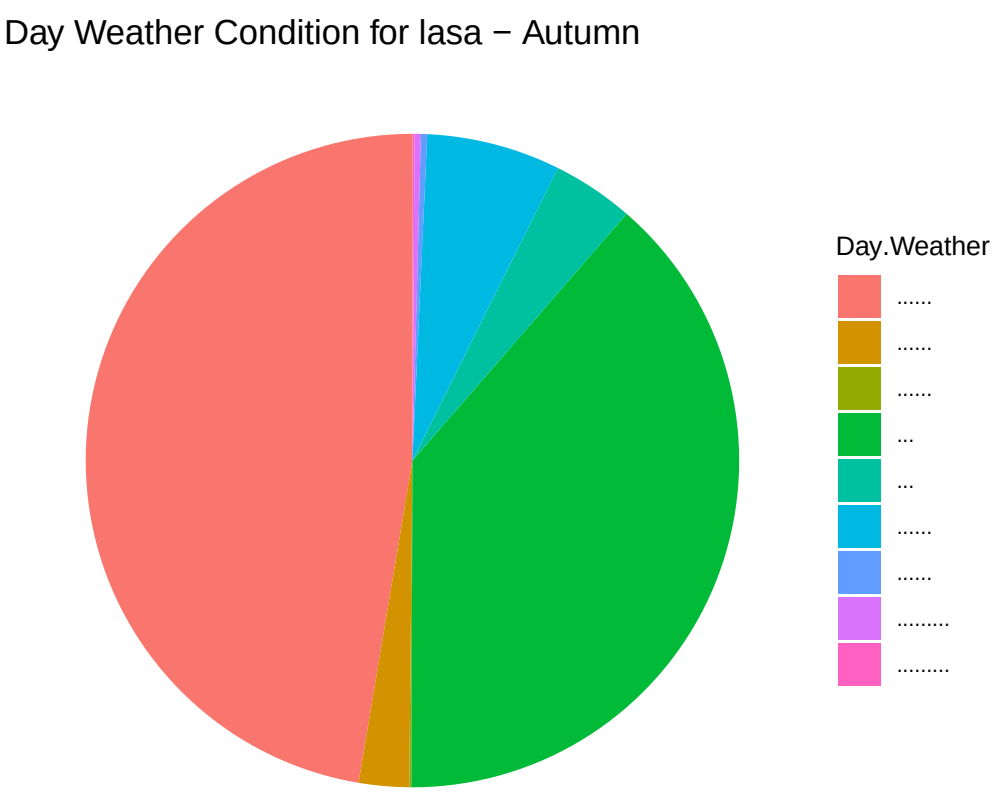
Day Weather Condition for lasa − Autumn
Day.Weather
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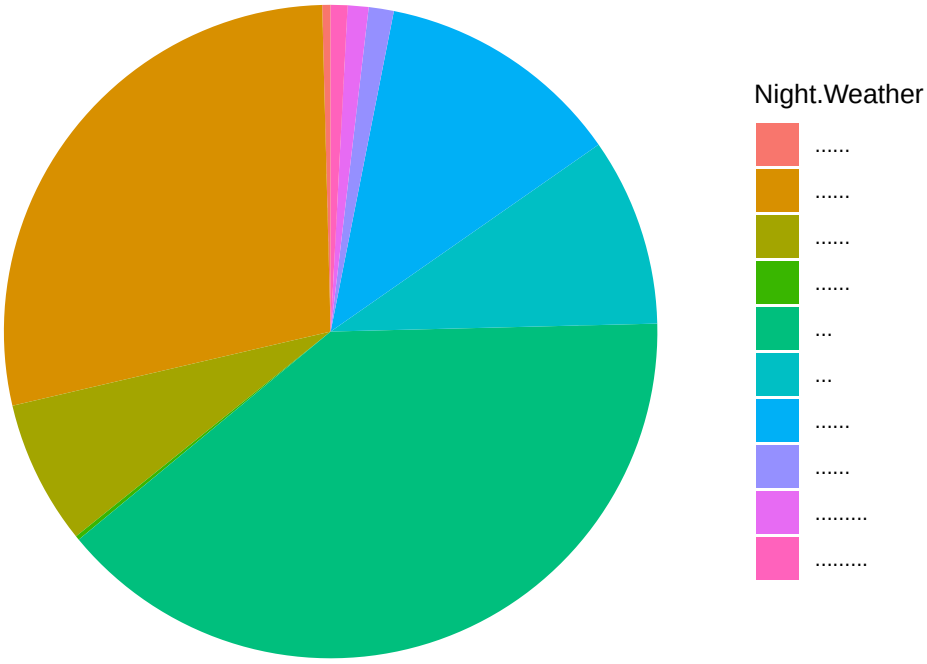
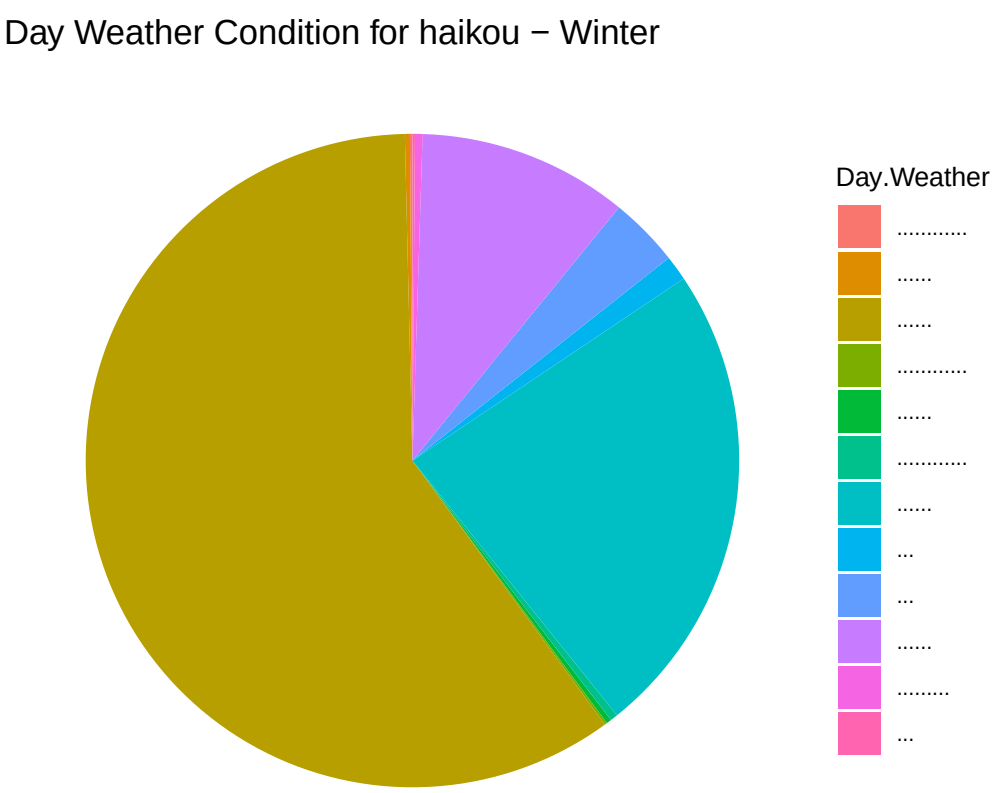
Night Weather Condition for lasa − Autumn




Day Weather Condition for haikou − Winter
Day.Weather
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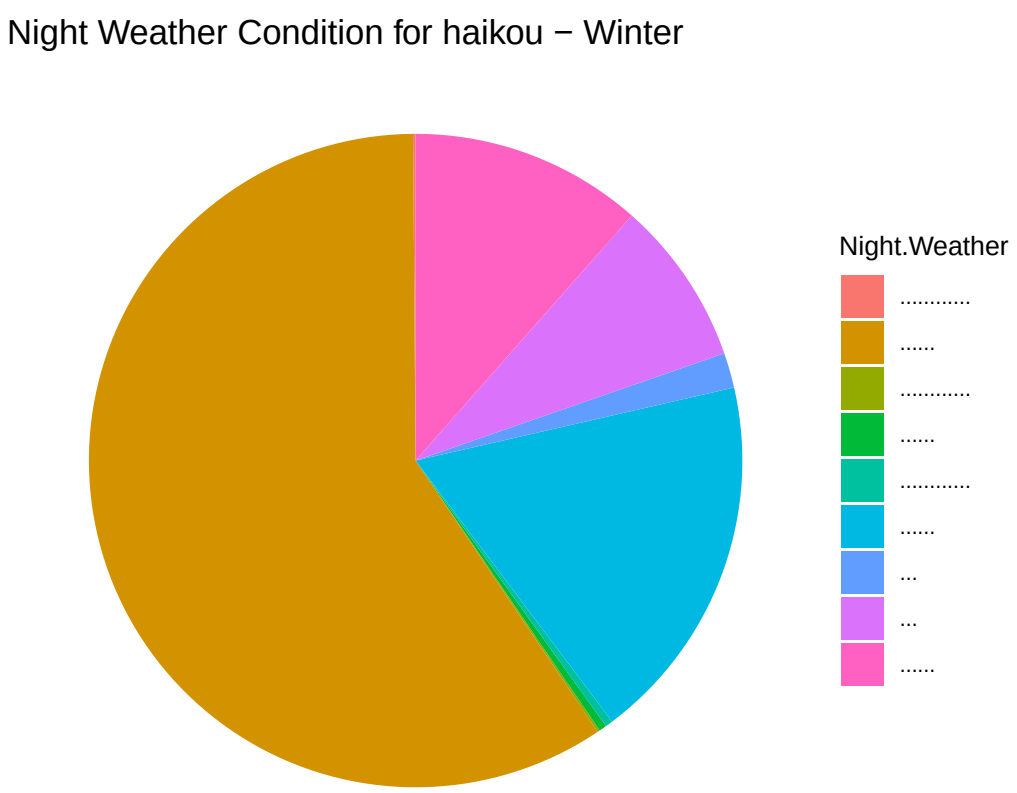
Night Weather Condition for haikou − Winter
Night.Weather
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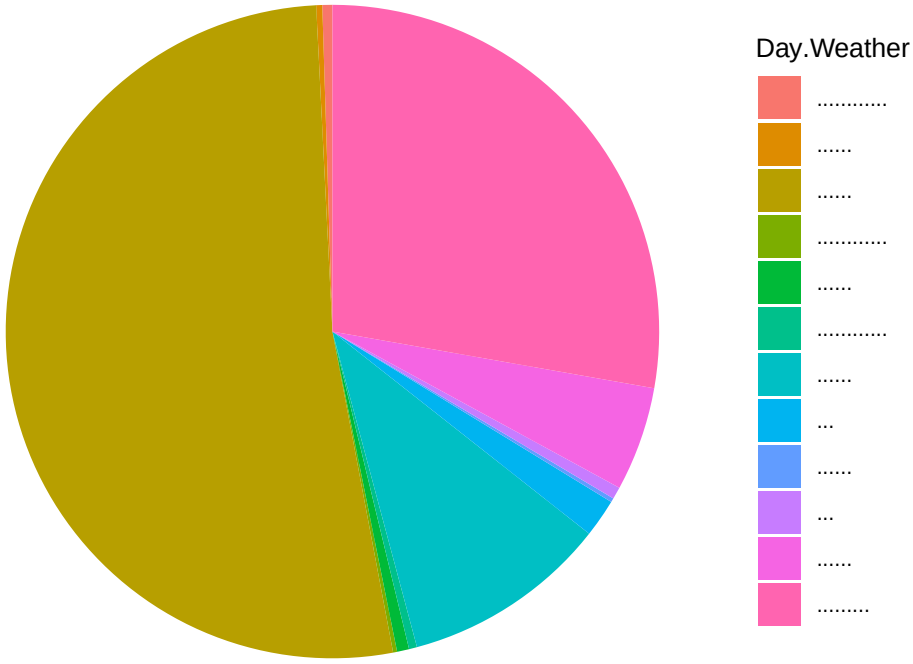
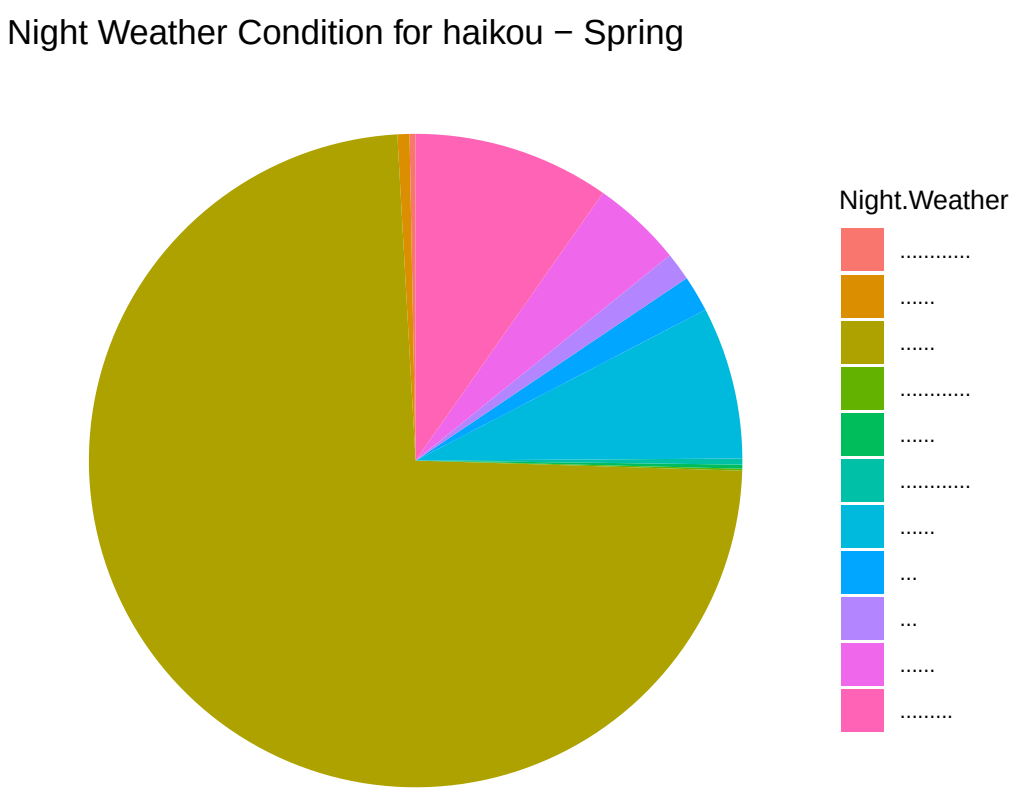
Day Weather Condition for haikou − Spring




Night Weather Condition for haikou − Spring
Night.Weather
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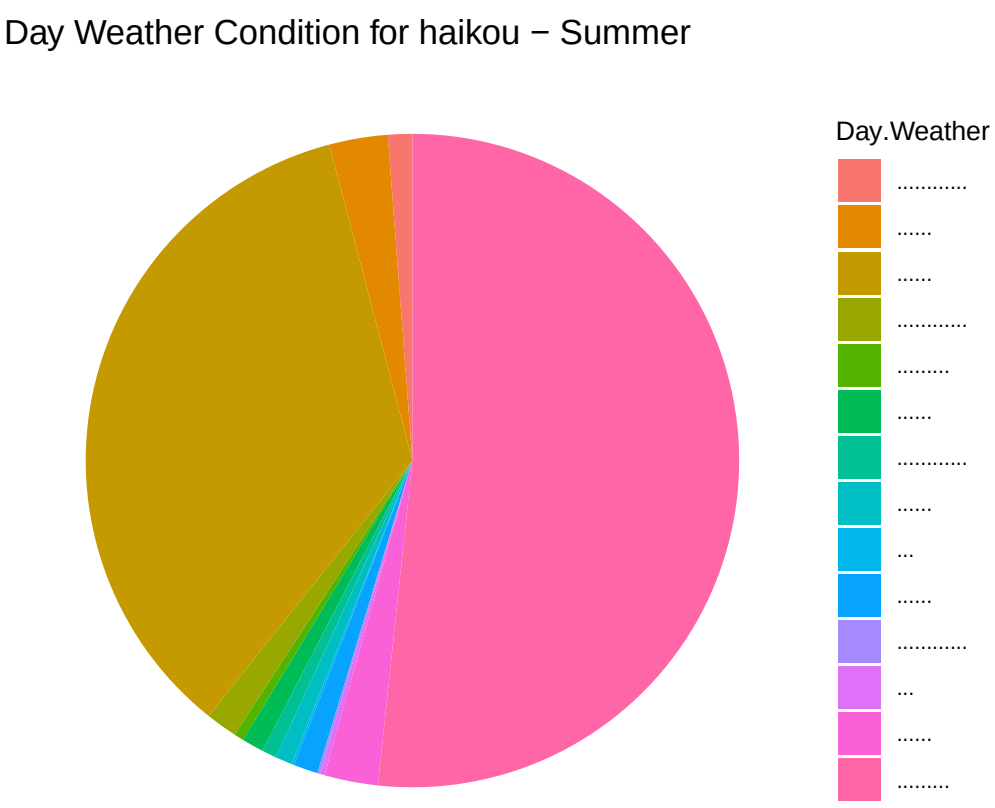
Day Weather Condition for haikou − Summer
Day.Weather
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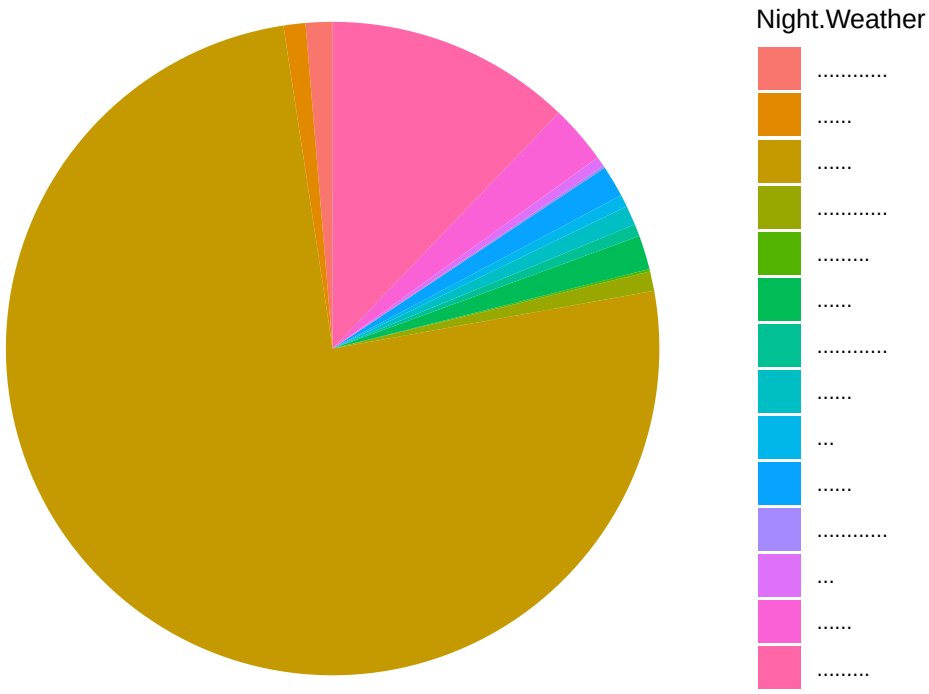
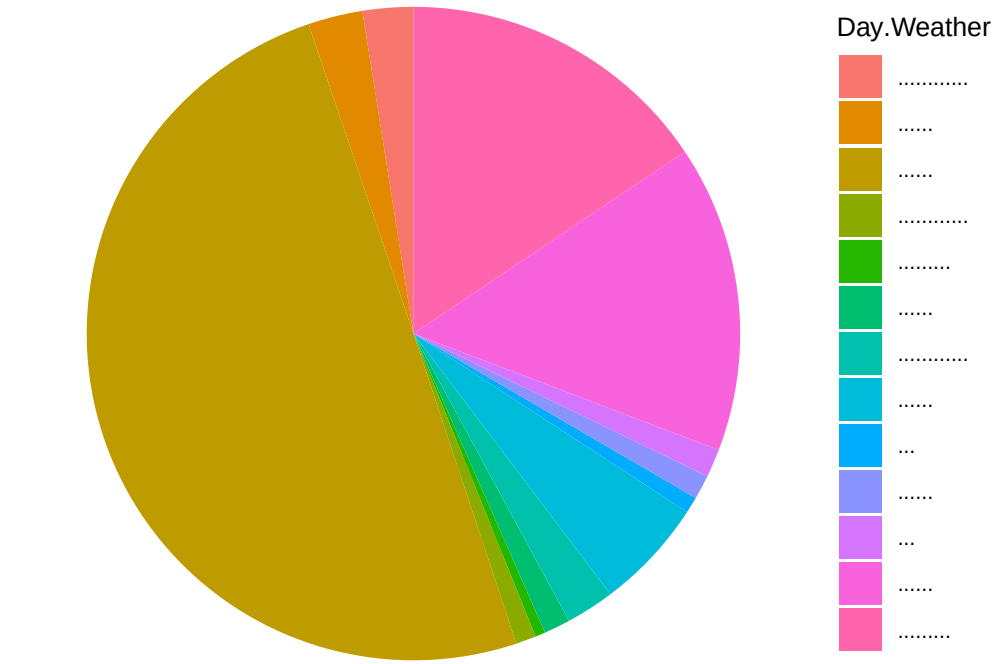
Night Weather Condition for haikou − Summer




Day Weather Condition for haikou − Autumn
Day.Weather
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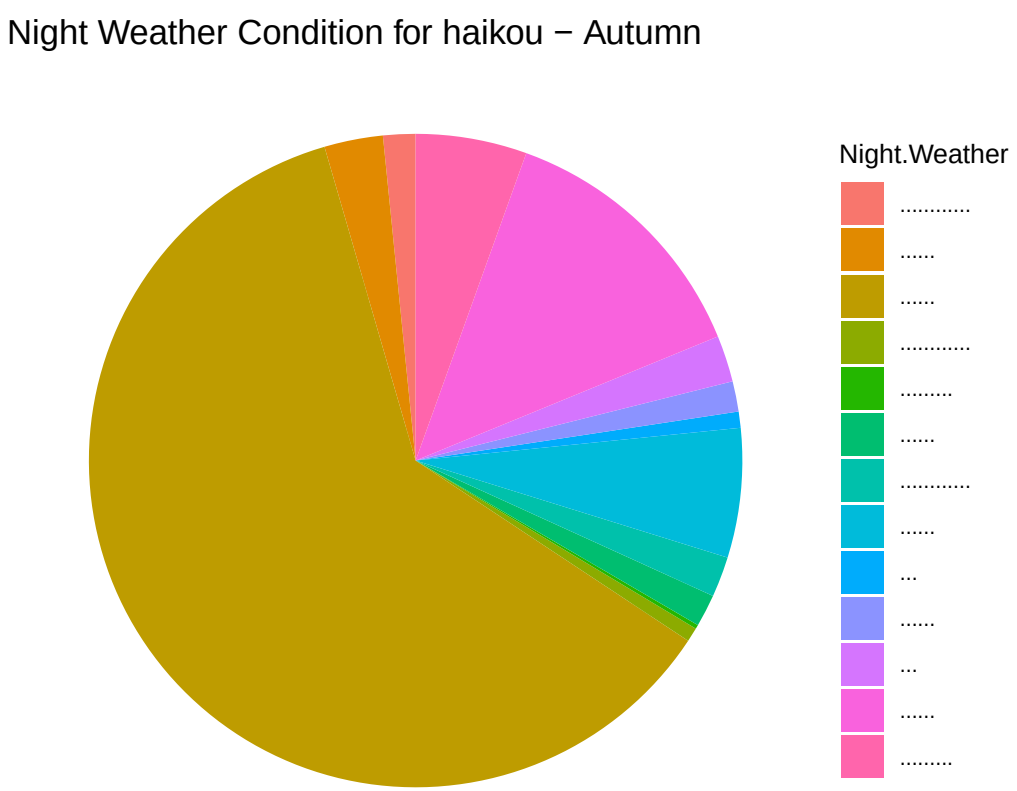
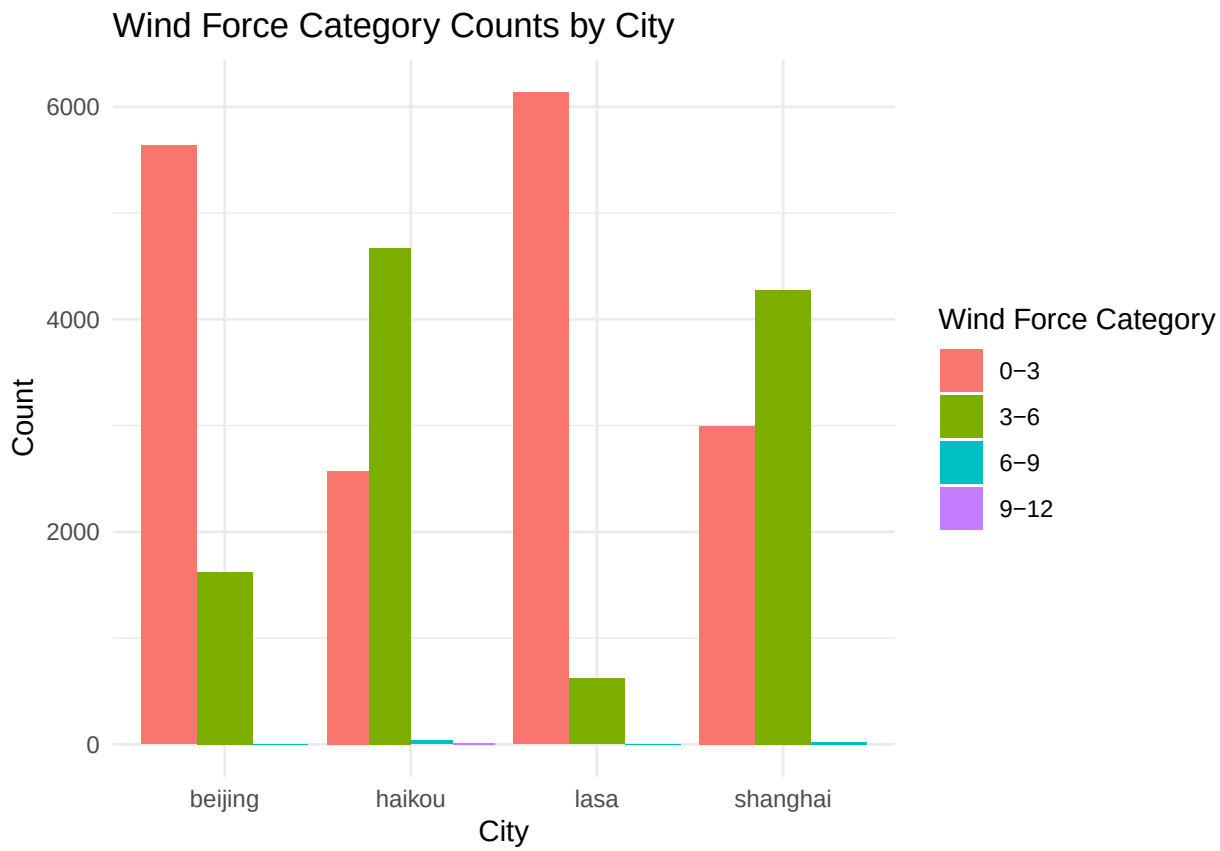
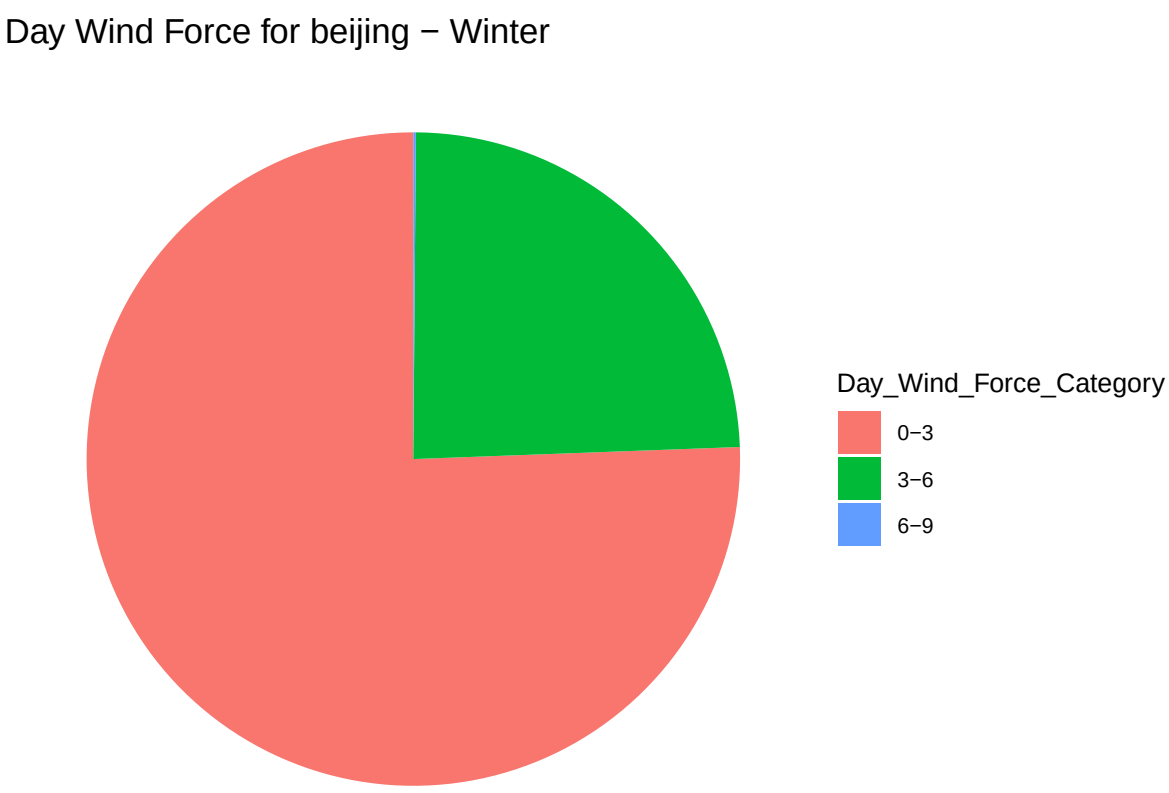


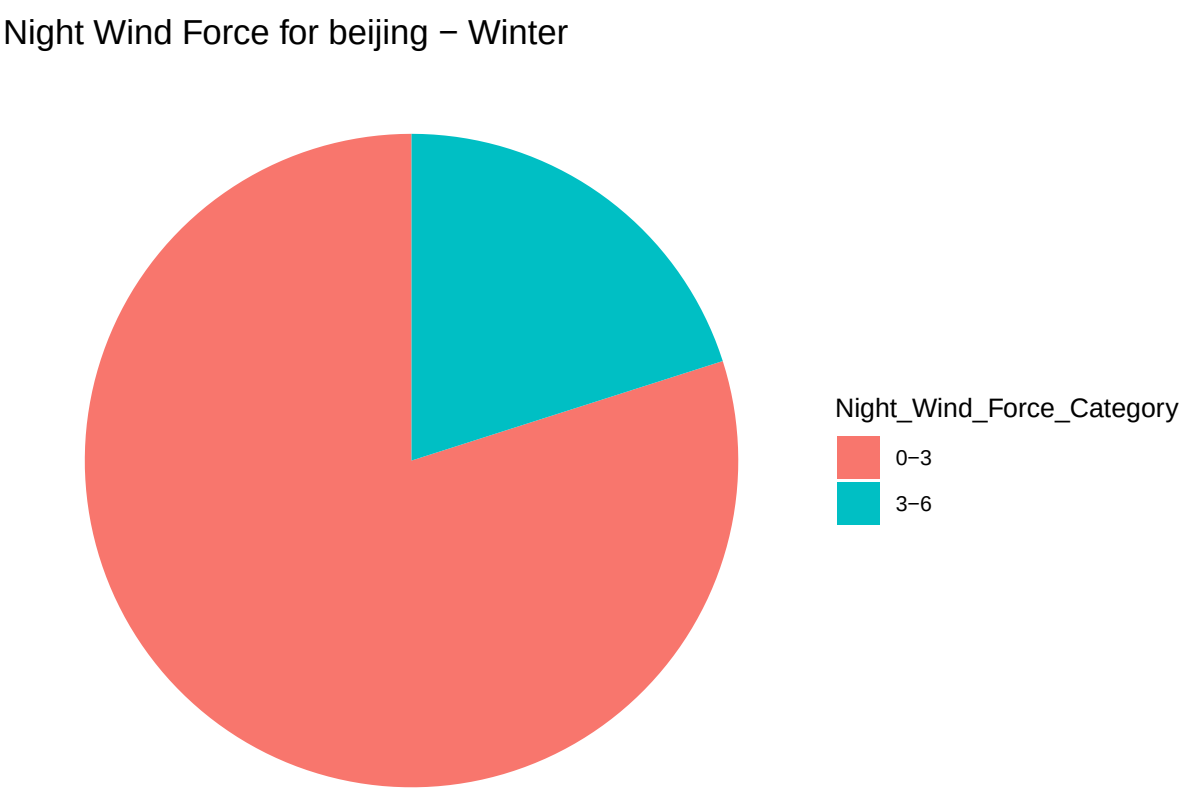

```
# Plot the value count of each city in the wind force categories
ggplot(df_long, aes(x = City, fill = Wind_Force_Category)) +
  geom_bar(position = "dodge") +
  labs(title = "Wind Force Category Counts by City",
       x = "City",
       y = "Count",
       fill = "Wind Force Category") +
  theme_minimal()
```

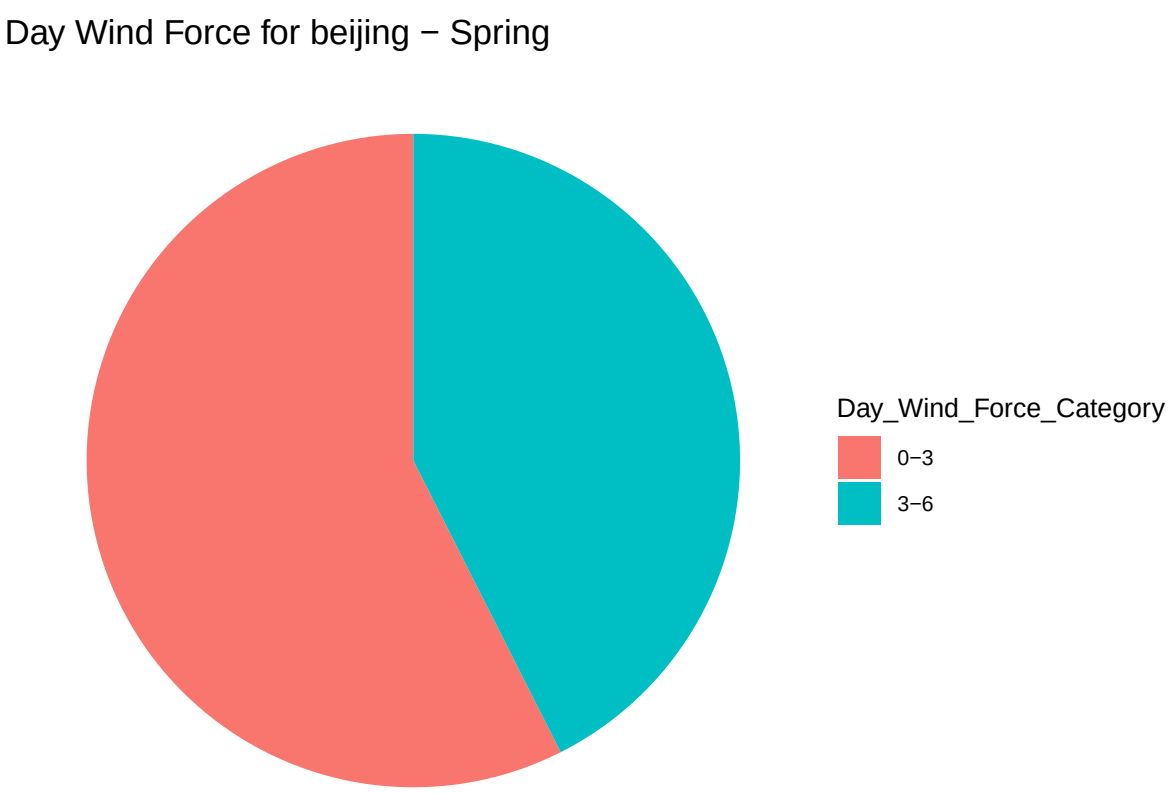


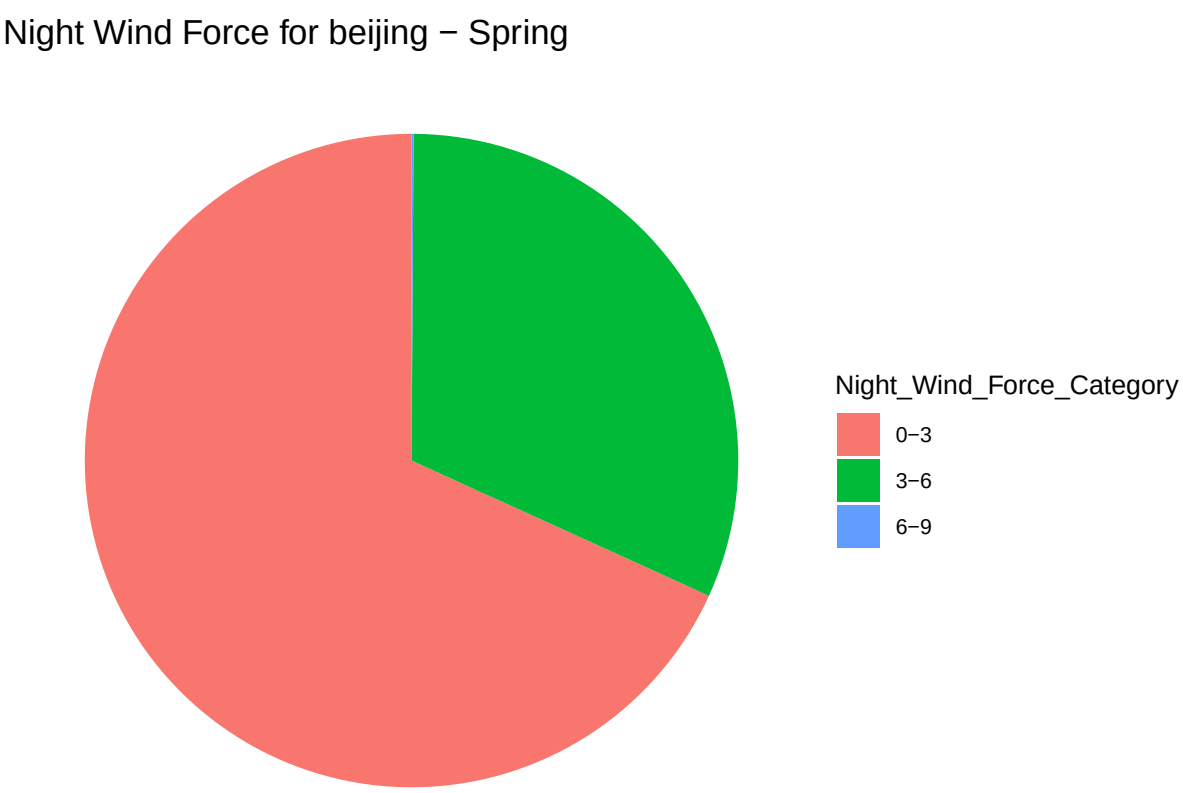

```r
# Count the occurrences of wind force by City and Season
day_wind_force_counts <- data %>%
  group_by(City, Season, Day_Wind_Force_Category) %>%
  tally() %>%
  ungroup()

night_wind_force_counts <- data %>%
  group_by(City, Season, Night_Wind_Force_Category) %>%
  tally() %>%
  ungroup()

# Function to plot pie chart for weather conditions or wind force by city and season
plot_pie_chart <- function(data, city, season, weather_column, title) {
  city_season_data <- data %>% filter(City == city & Season == season)
  p <- ggplot(city_season_data, aes(x = "", y = n, fill = !!sym(weather_column))) +
    geom_bar(stat = "identity", width = 1) +
    coord_polar(theta = "y") +
    labs(title = paste(title, "for", city, "-", season), fill = weather_column) +
    theme_void() +
    theme(legend.position = "right",  # Move legend outside the plot
          legend.title = element_text(size = 10), # Adjust the legend title size
          legend.text = element_text(size = 8))   # Adjust the legend text size
  return(p)
}

# Loop through cities and seasons to plot pie charts for Day and Night weather conditions and wind forc
```

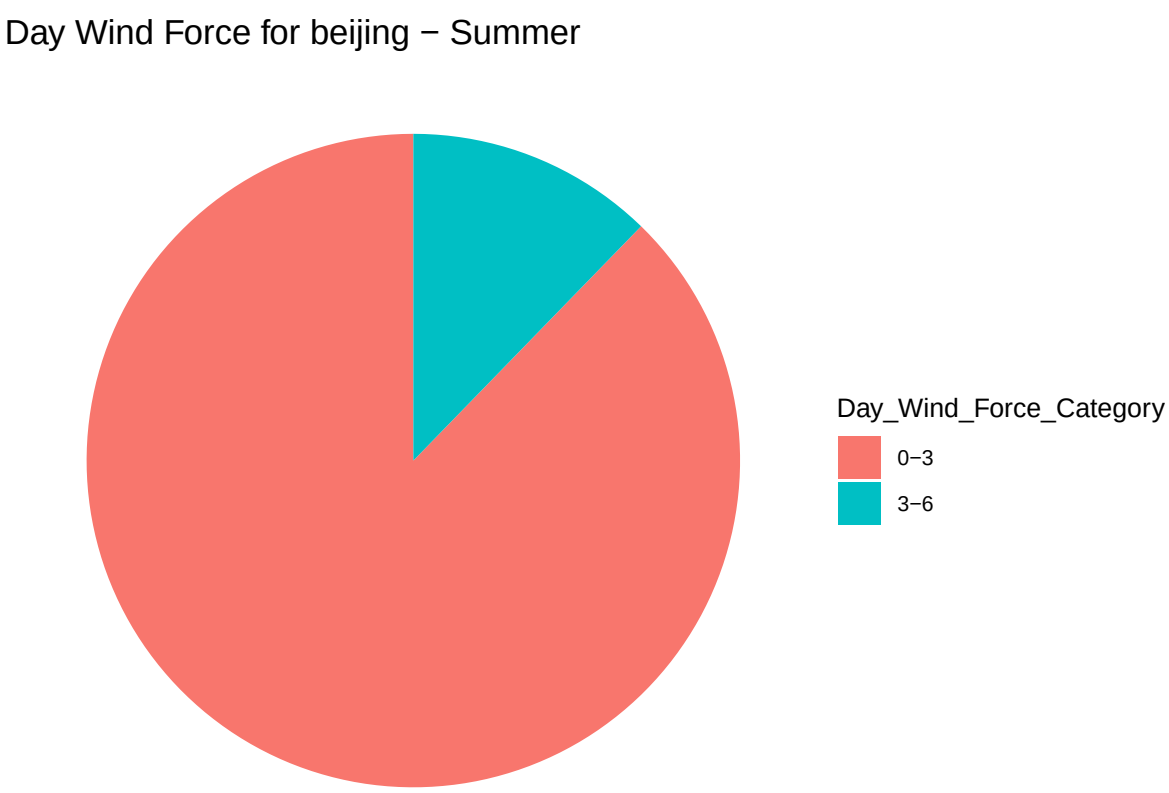
```r
cities <- unique(data$City)
seasons <- unique(data$Season)

for (city in cities) {
  for (season in seasons) {
    # Day Wind Force Pie Chart
    day_wind_plot <- plot_pie_chart(day_wind_force_counts, city, season, "Day_Wind_Force_Category", "Da
    print(day_wind_plot)

    # Night Wind Force Pie Chart
    night_wind_plot <- plot_pie_chart(night_wind_force_counts, city, season, "Night_Wind_Force_Category
    print(night_wind_plot)
  }
}
```

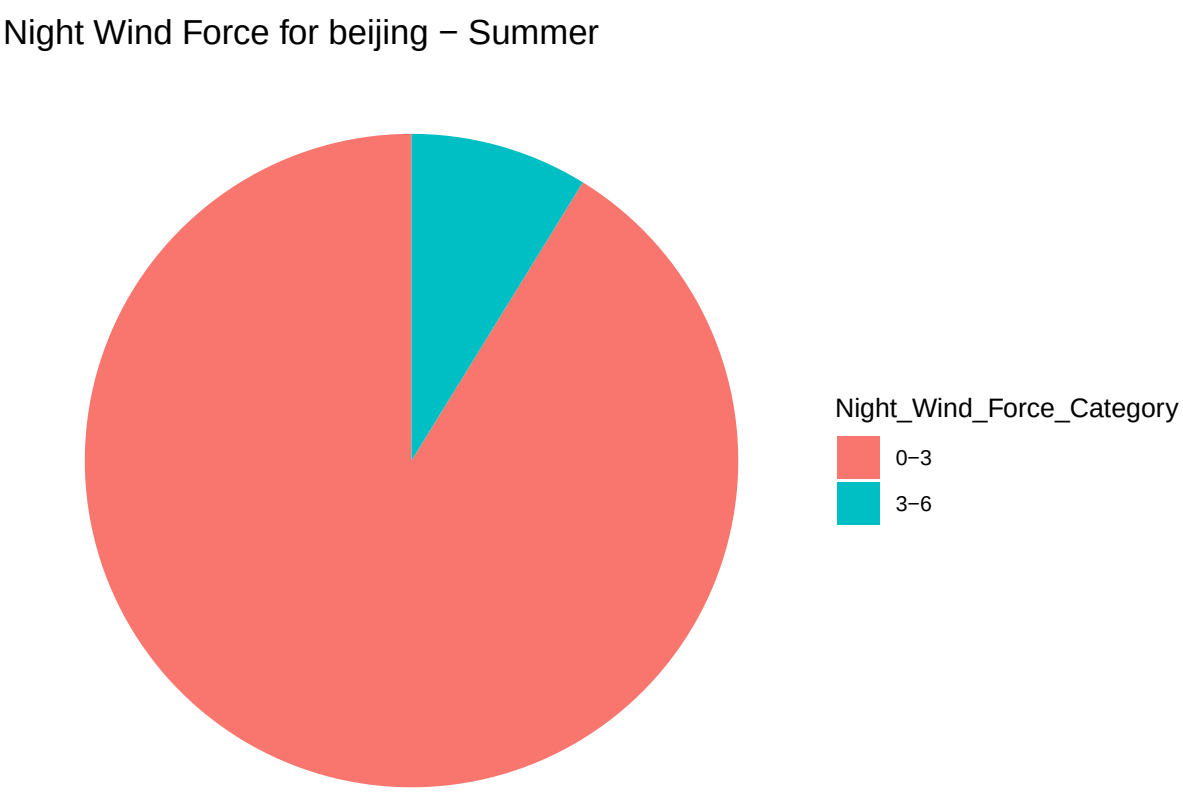


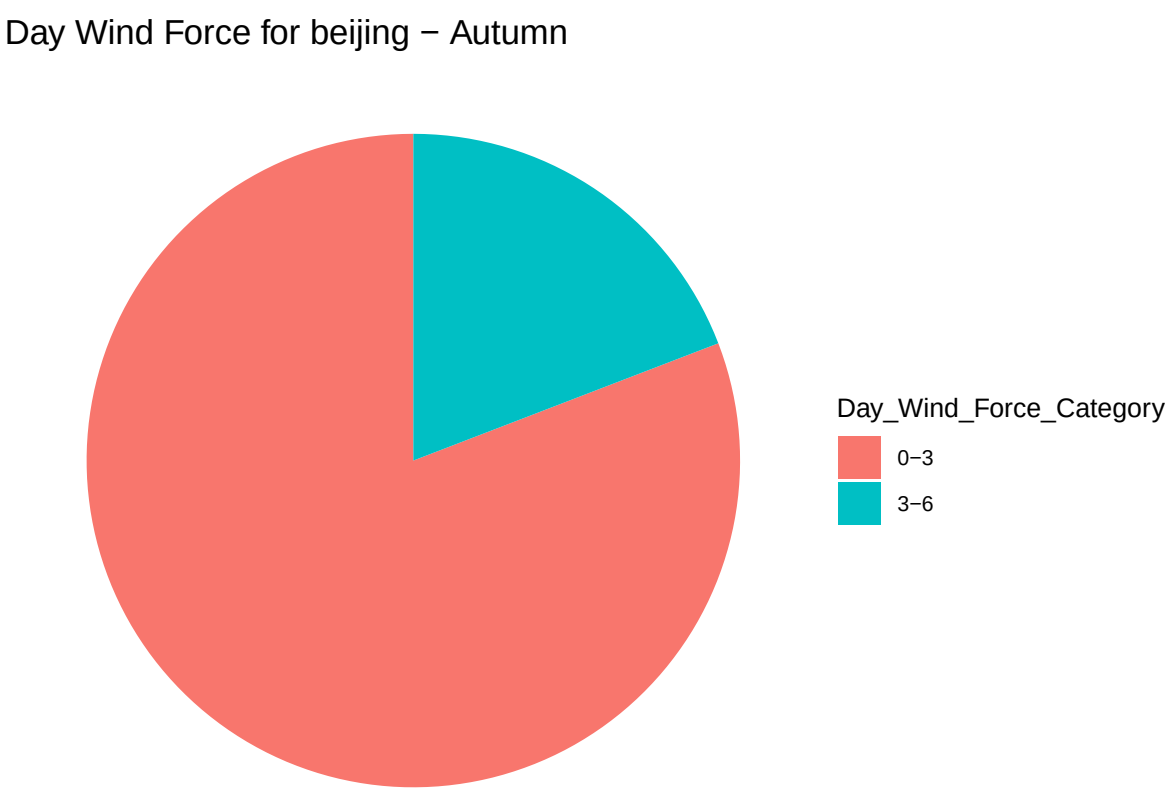

Night Wind Force for beijing − Winter
Night_Wind_Force_Category
0−3
3−6


Day Wind Force for beijing − Spring
Day_Wind_Force_Category
0−3
3−6

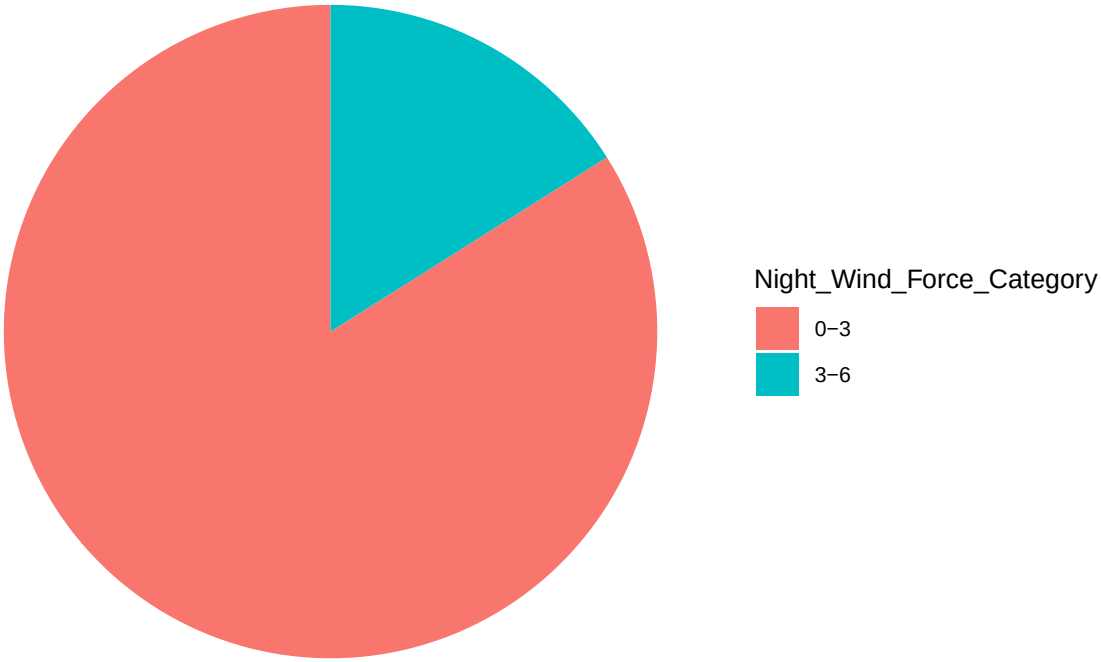

Night Wind Force for beijing − Spring
Night_Wind_Force_Category
0−3
3−6
6−9

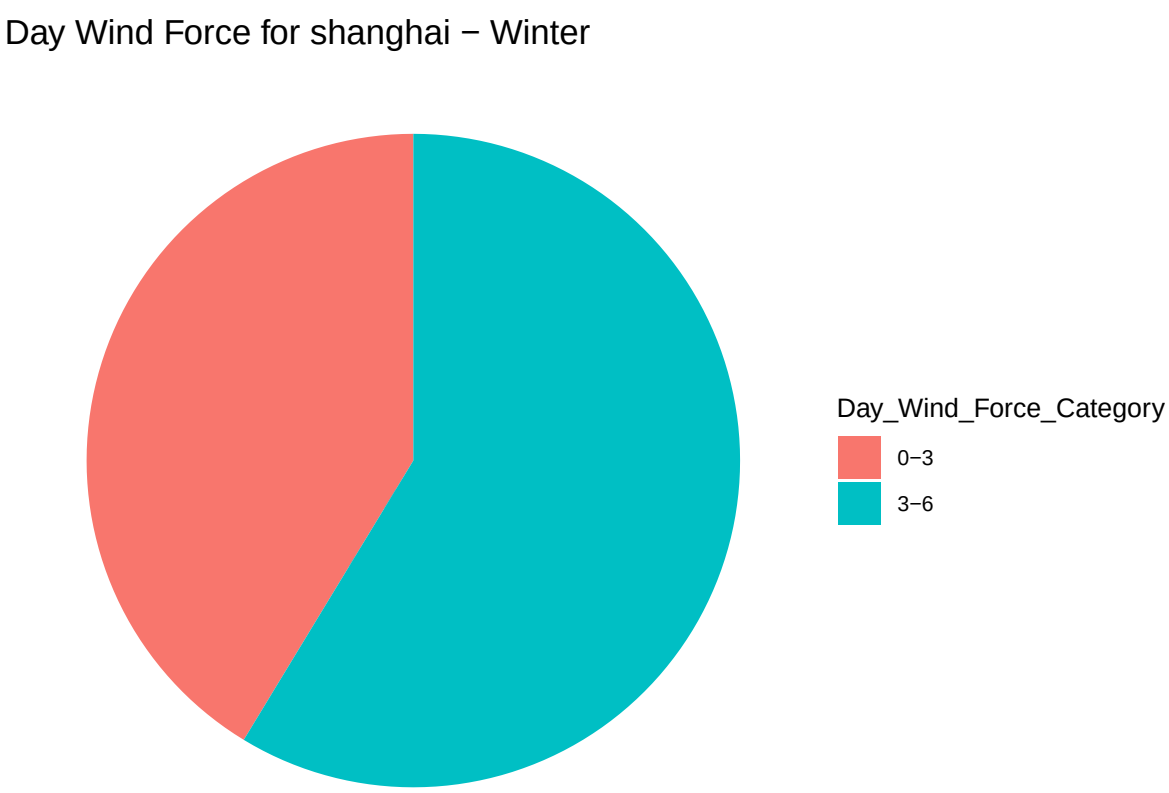

Day Wind Force for beijing − Summer
Day_Wind_Force_Category
0−3
3−6


Night Wind Force for beijing − Summer
Night_Wind_Force_Category
0−3
3−6

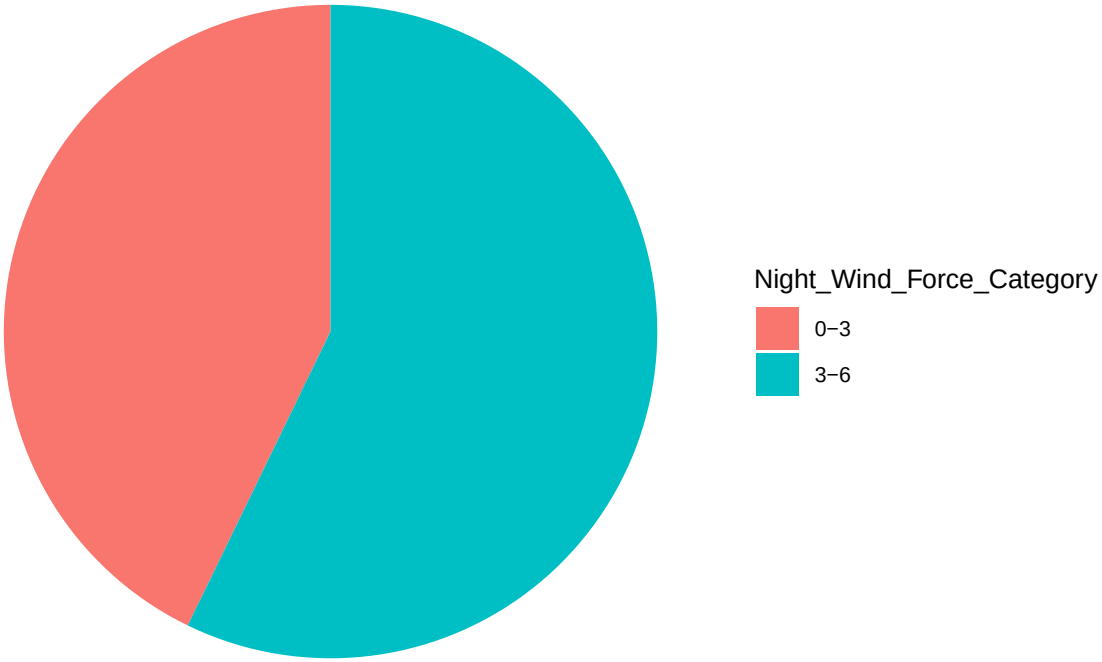

Day Wind Force for beijing − Autumn
Day_Wind_Force_Category
0−3
3−6

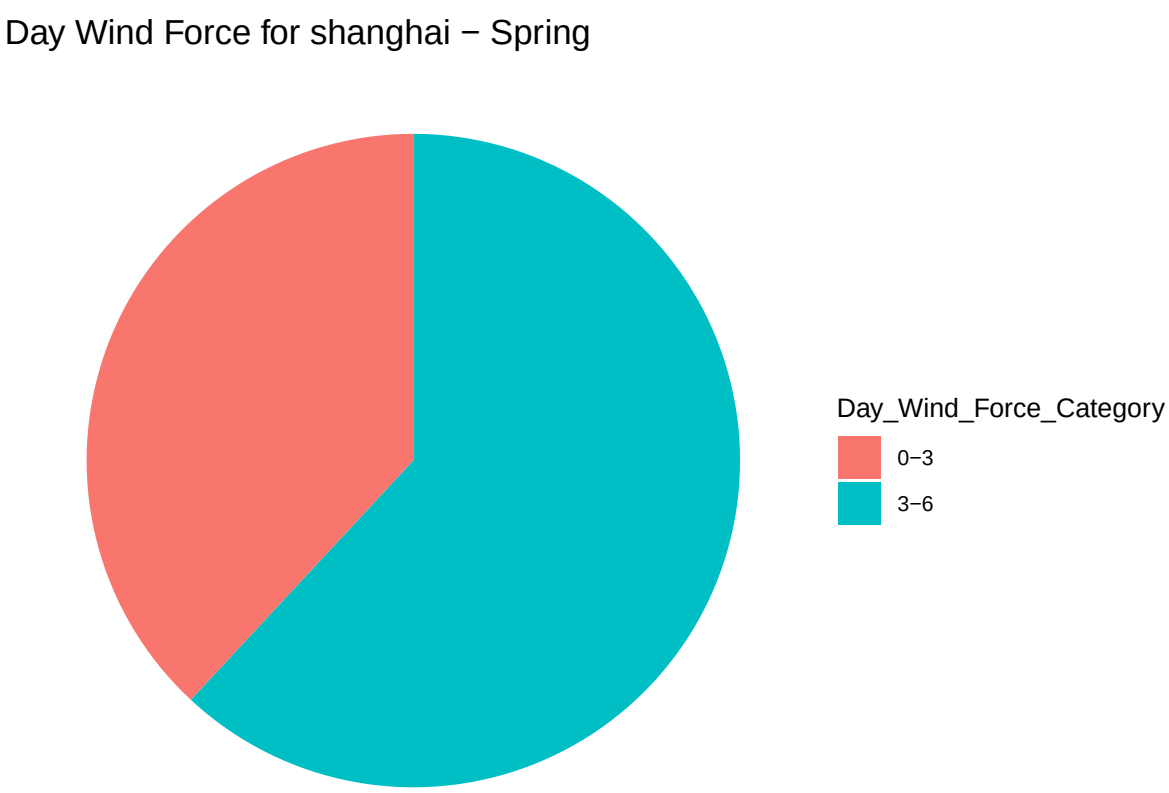
Night Wind Force for beijing − Autumn

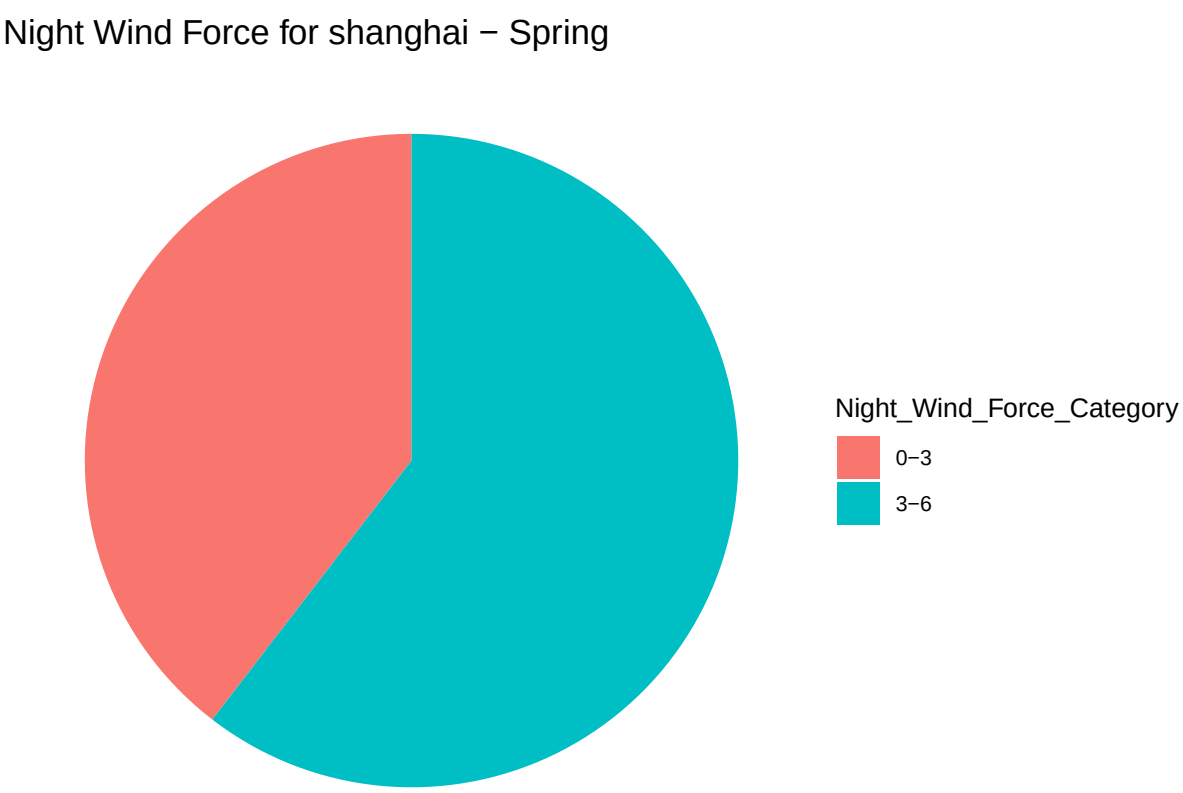


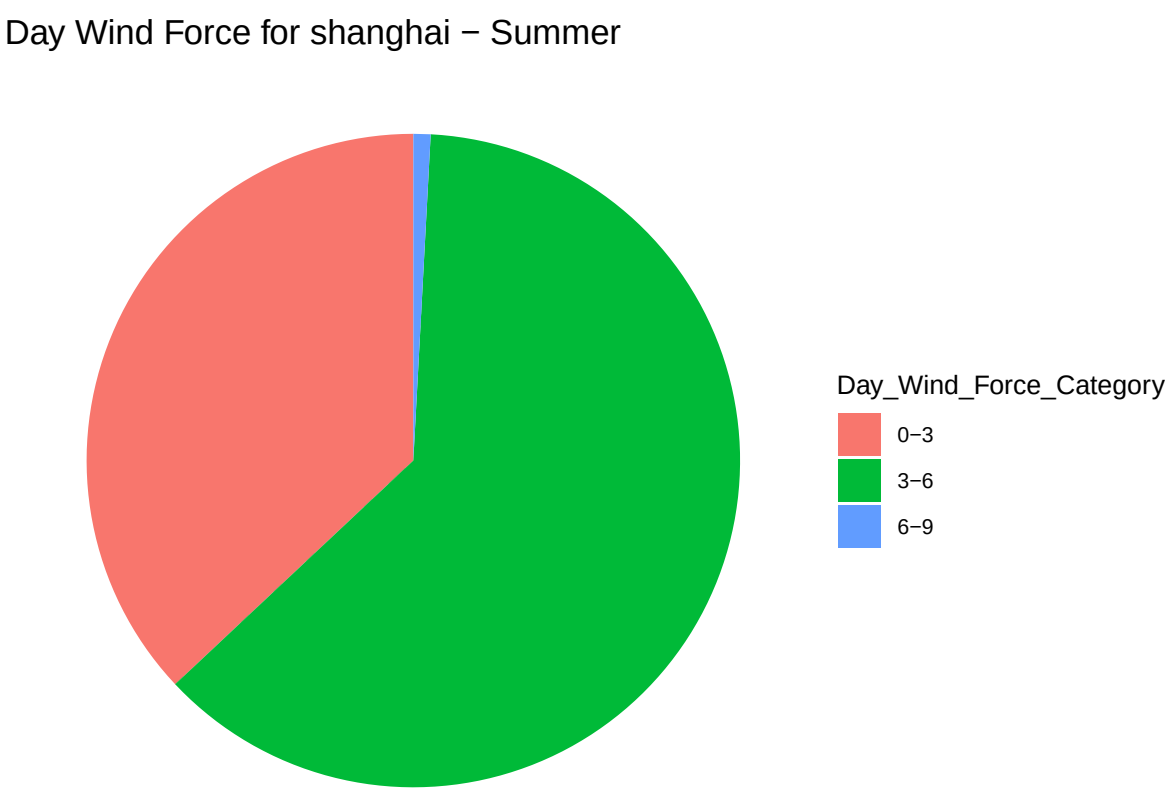

Day Wind Force for shanghai − Winter
Day_Wind_Force_Category
0−3
3−6

Night Wind Force for shanghai − Winter

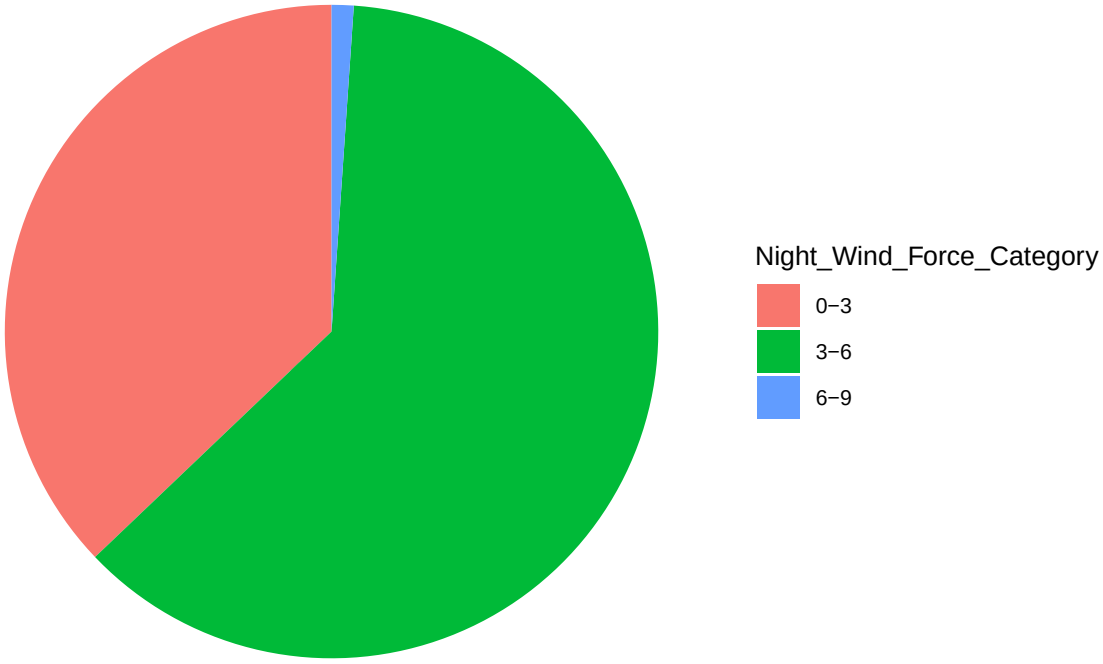


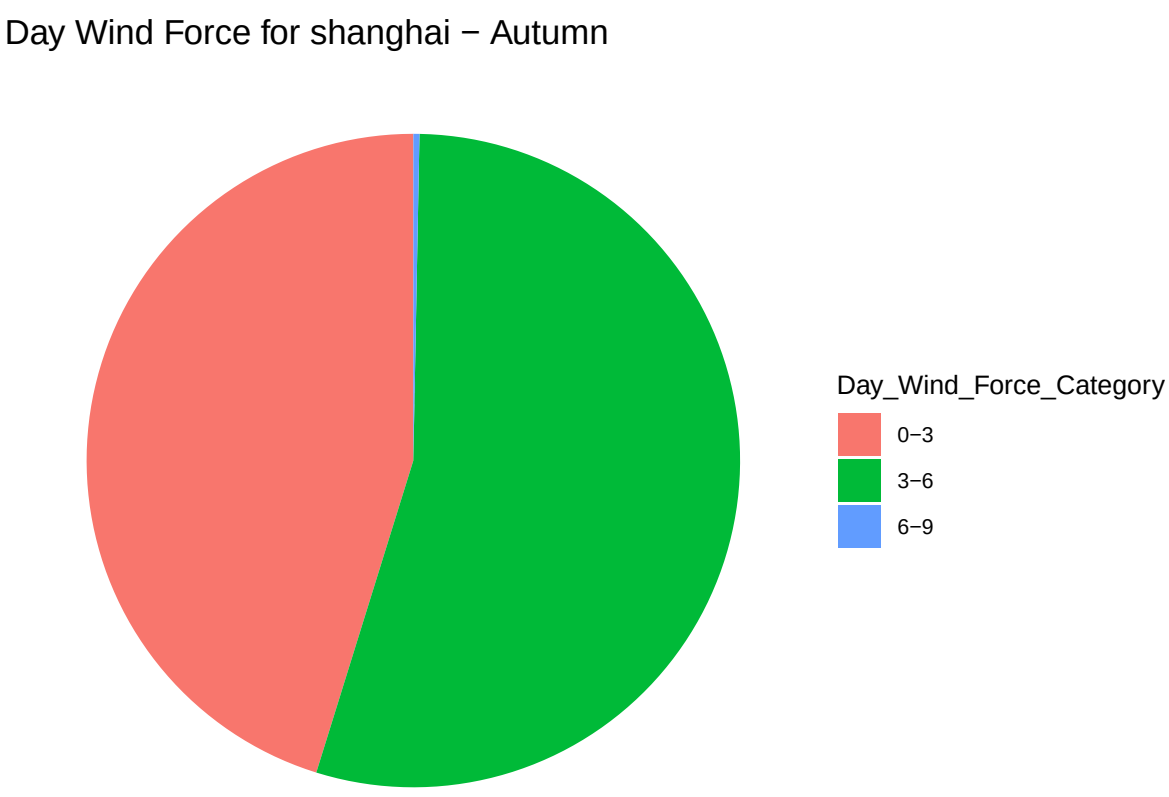

Day Wind Force for shanghai − Spring
Day_Wind_Force_Category
0−3
3−6

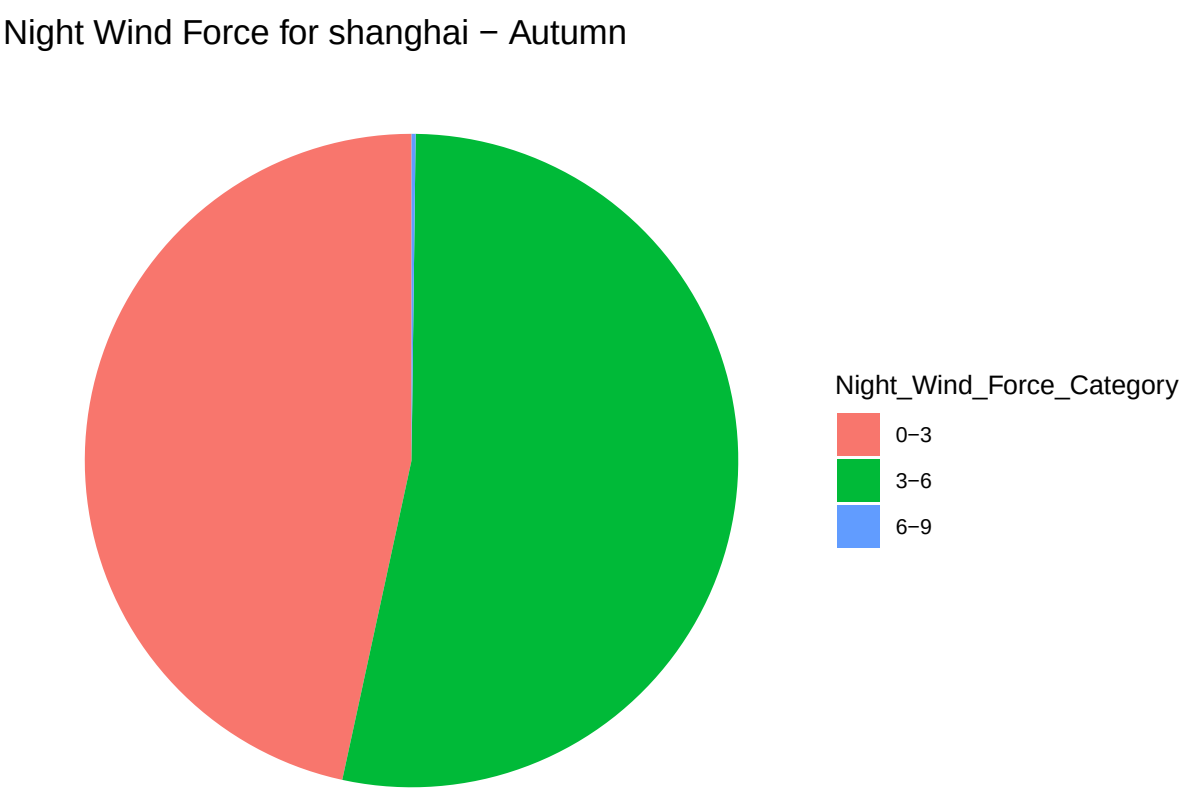

Night Wind Force for shanghai − Spring
Night_Wind_Force_Category
0−3
3−6


Day Wind Force for shanghai − Summer
Day_Wind_Force_Category
0−3
3−6
6−9

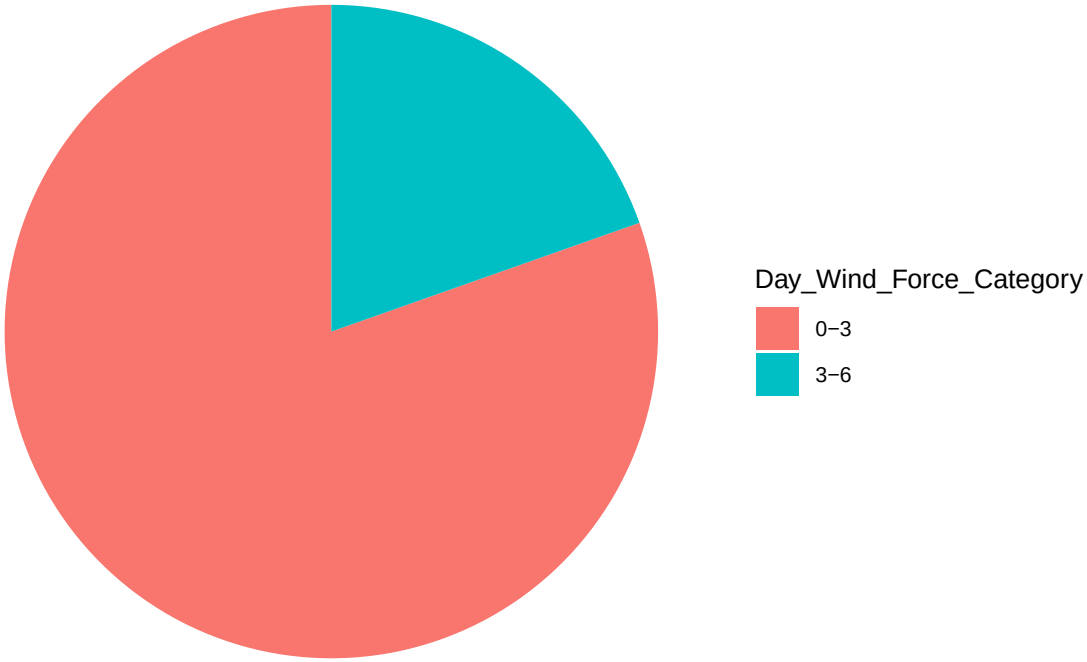
Night Wind Force for shanghai − Summer



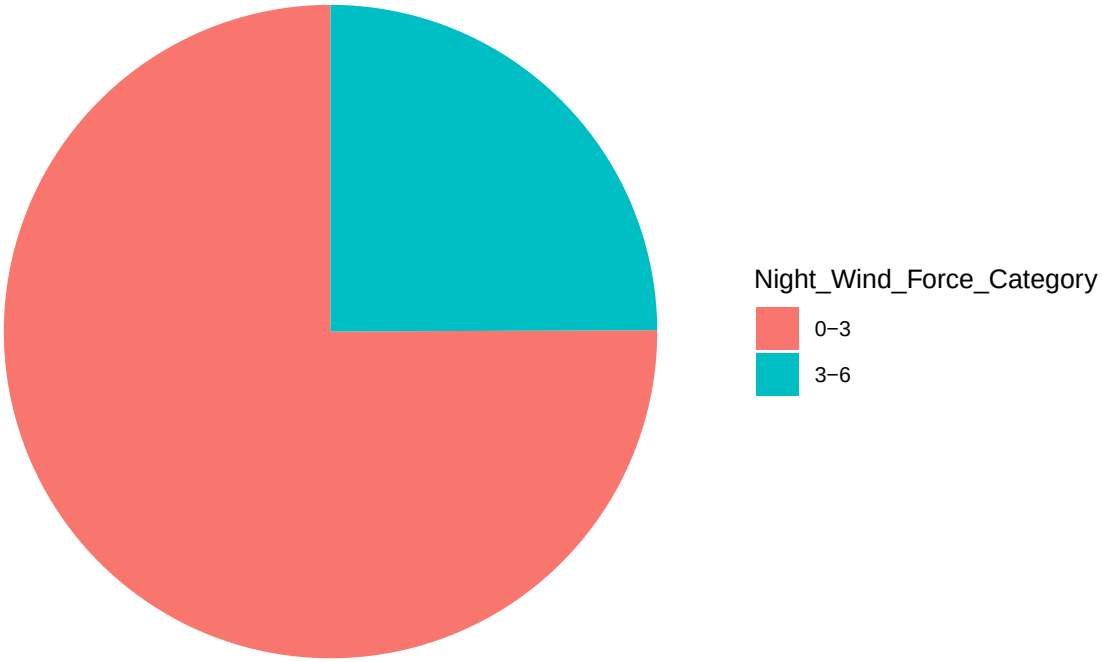

Day Wind Force for shanghai − Autumn
Day_Wind_Force_Category
0−3
3−6
6−9

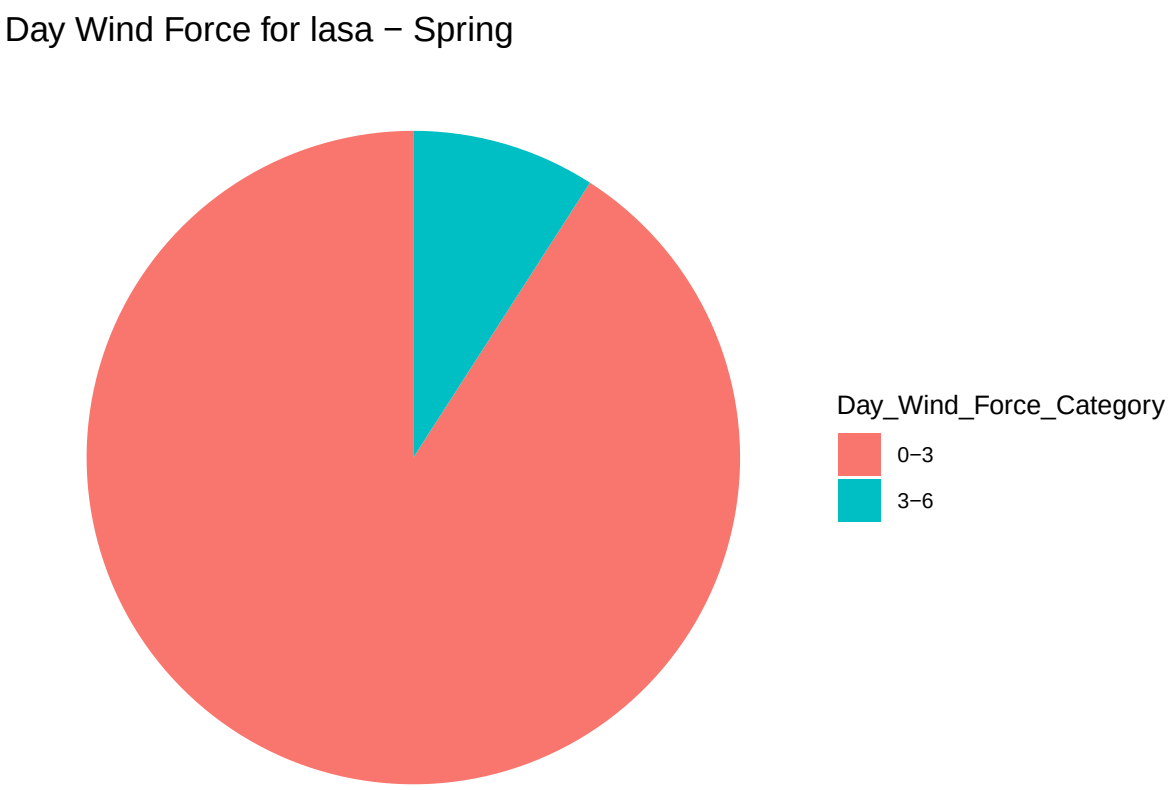

Night Wind Force for shanghai − Autumn
Night_Wind_Force_Category
0−3
3−6
6−9

Day Wind Force for lasa − Winter

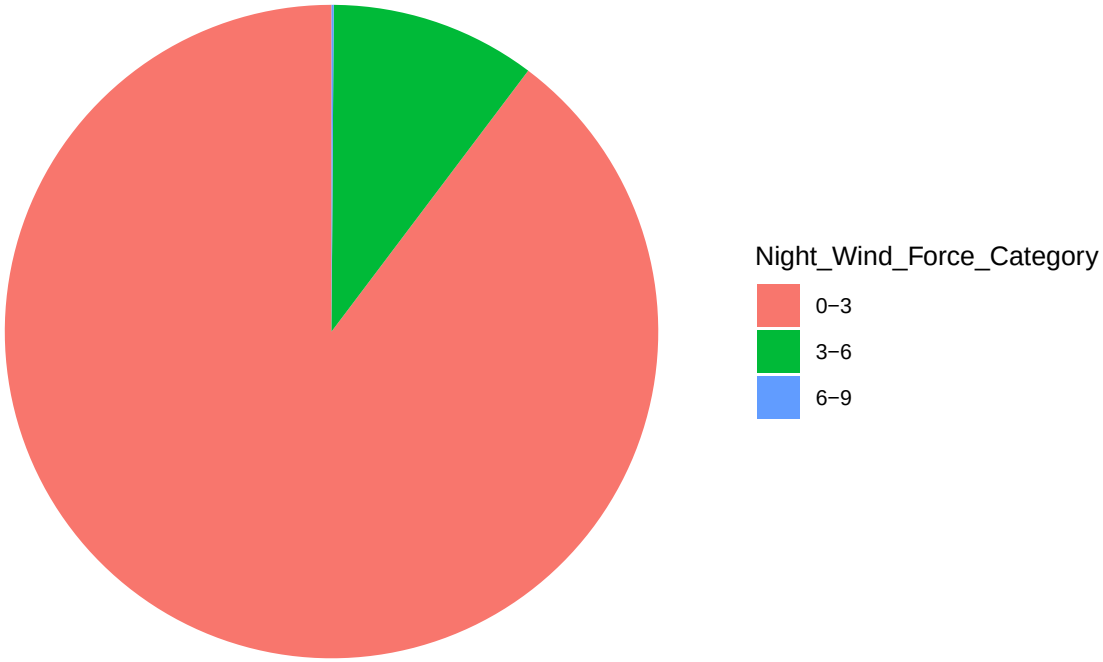


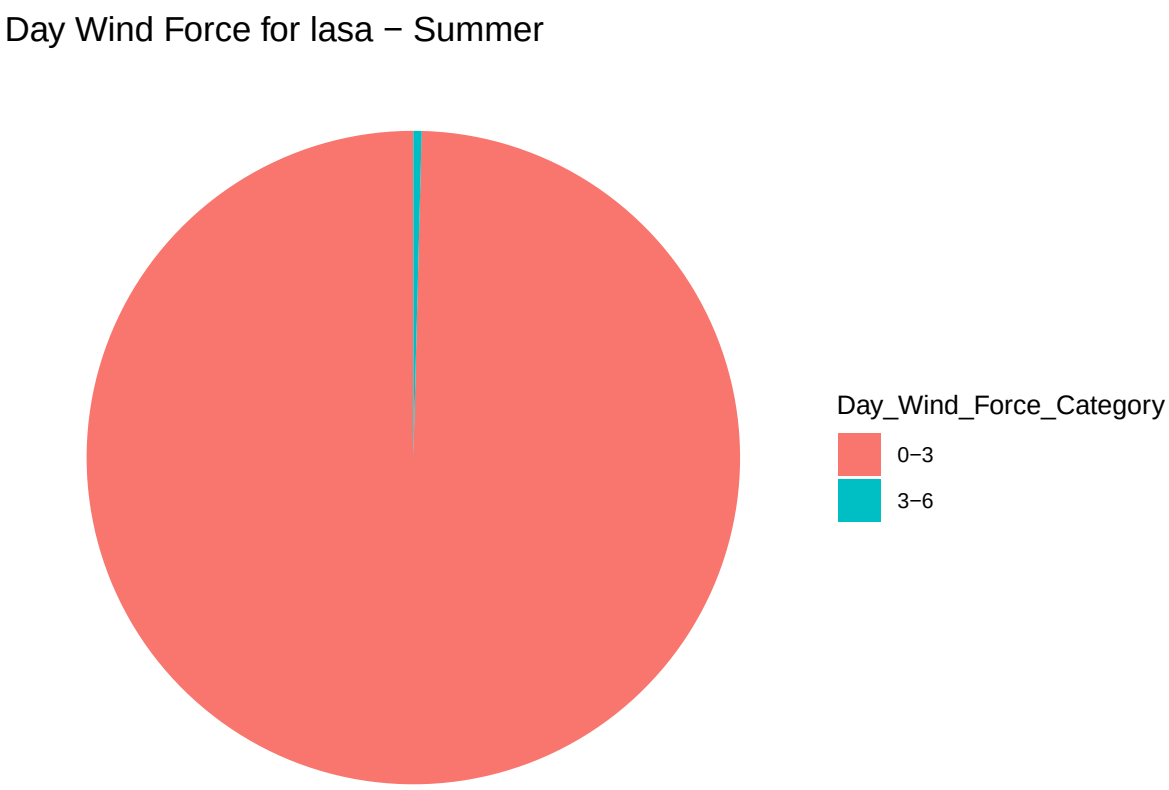
Night Wind Force for lasa − Winter

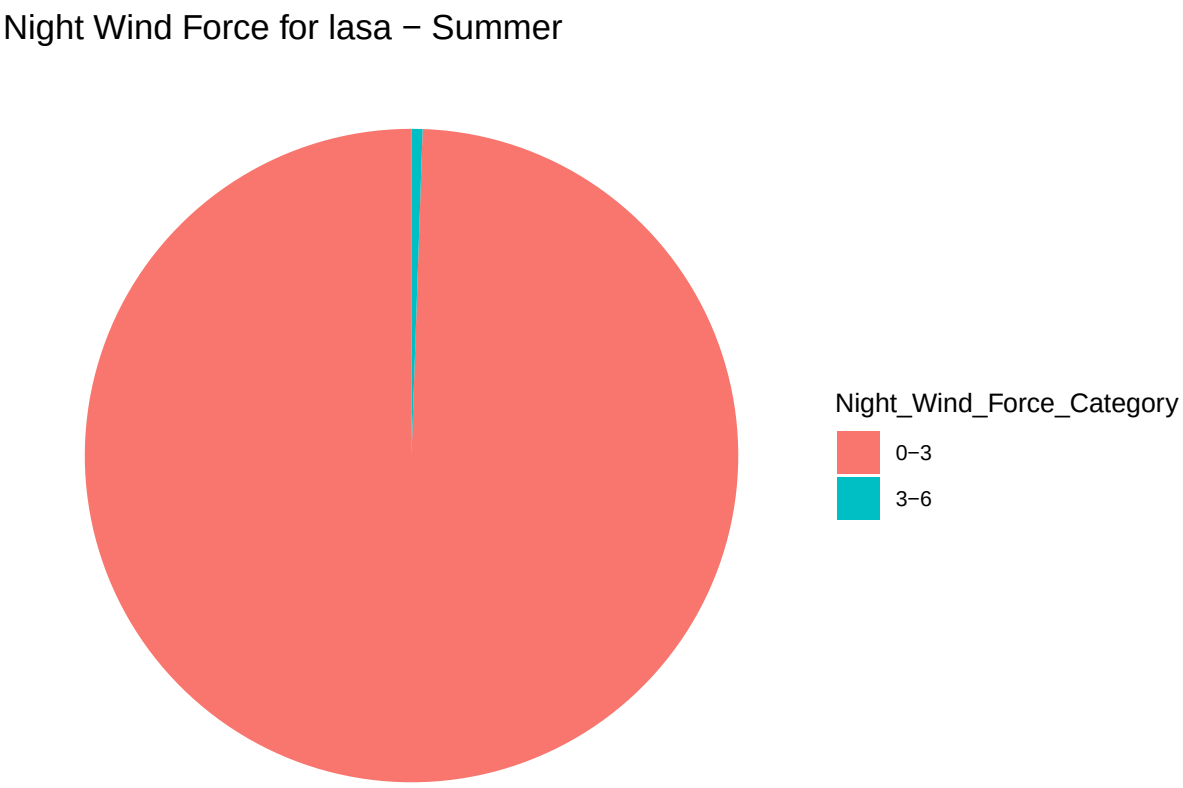


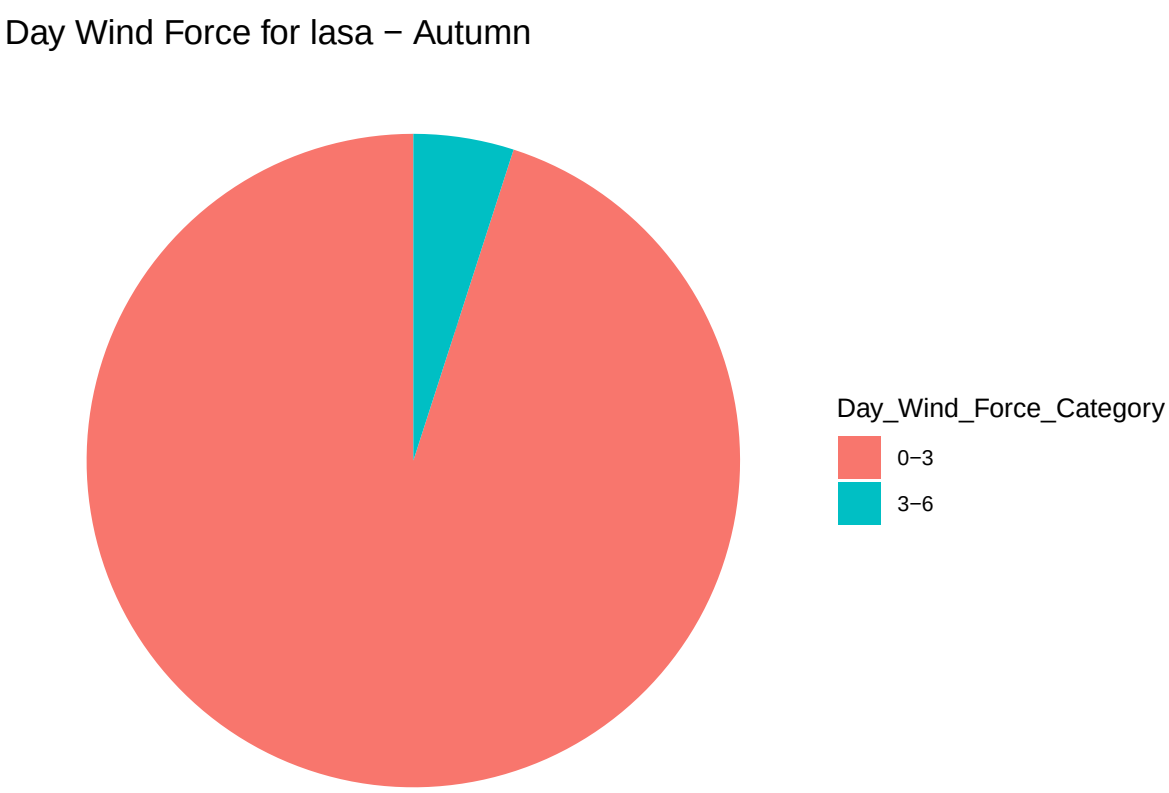

Day Wind Force for lasa − Spring
Day_Wind_Force_Category
0−3
3−6

Night Wind Force for lasa − Spring

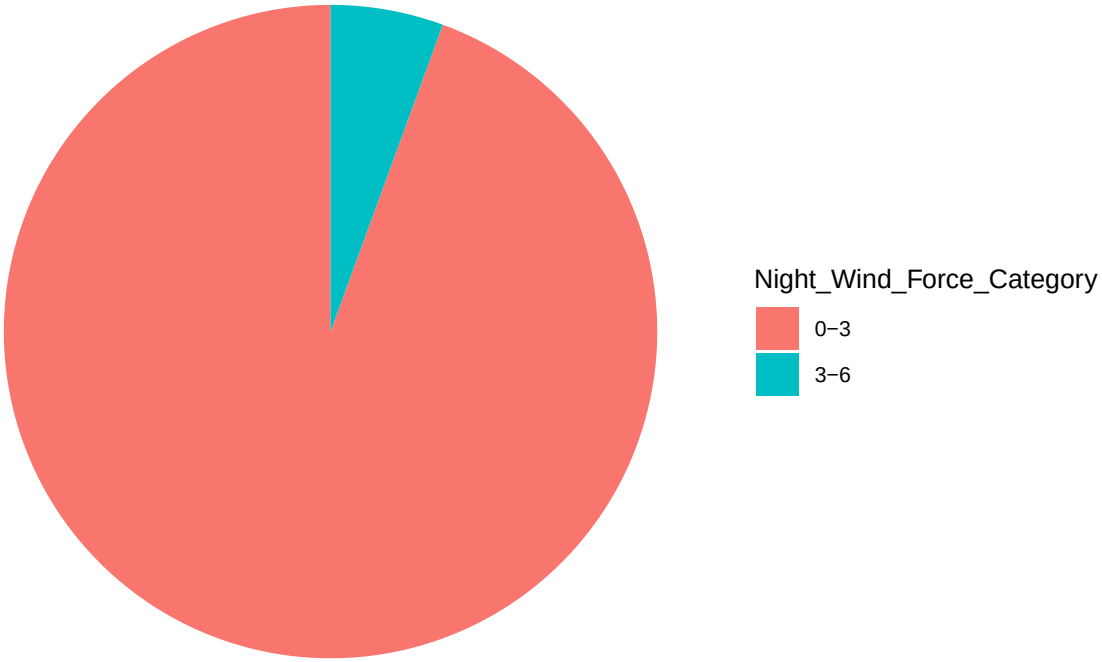



Day Wind Force for lasa − Summer
Day_Wind_Force_Category
0−3
3−6

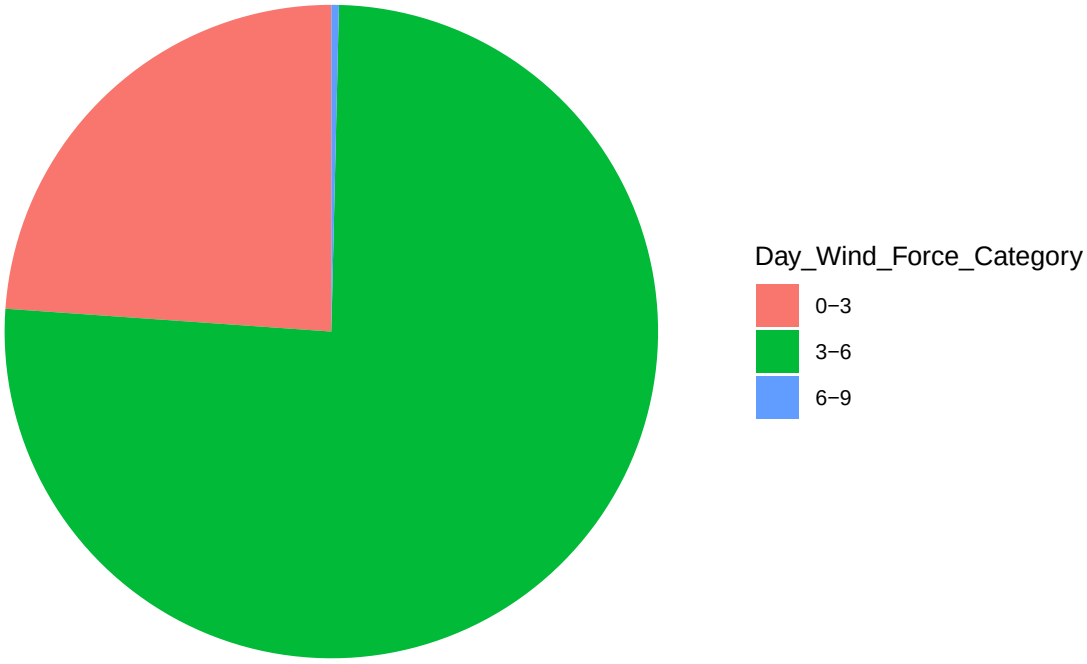

Night Wind Force for lasa − Summer
Night_Wind_Force_Category
0−3
3−6


Day Wind Force for lasa − Autumn
Day_Wind_Force_Category
0−3
3−6

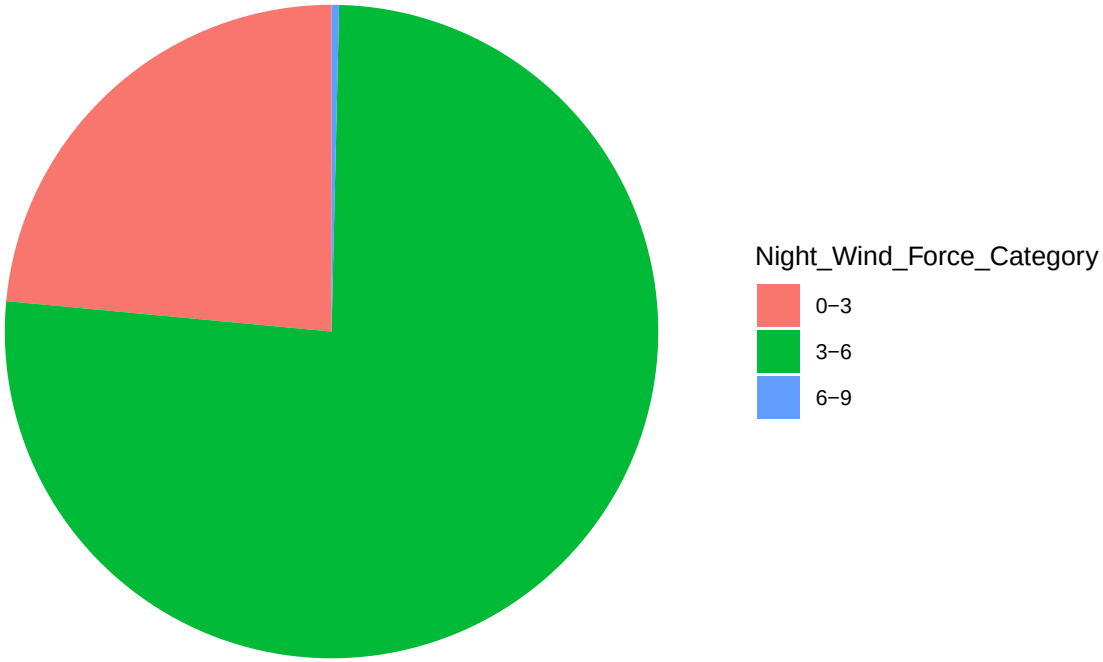
Night Wind Force for lasa − Autumn

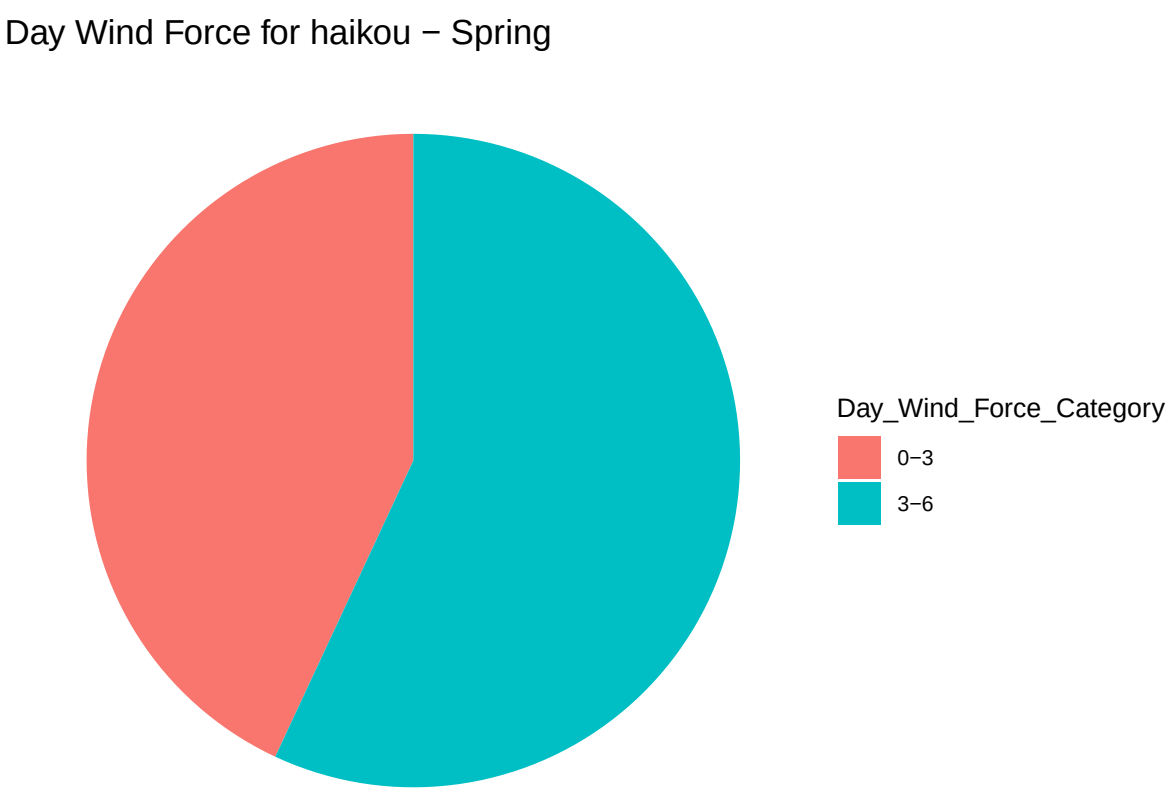


Day Wind Force for haikou − Winter

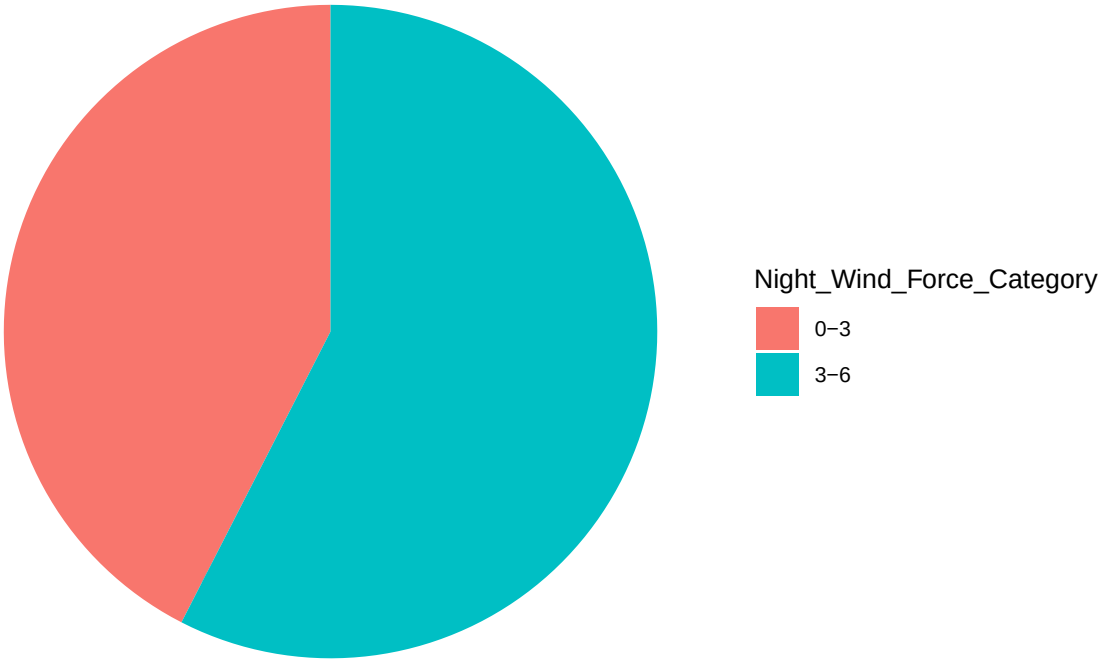


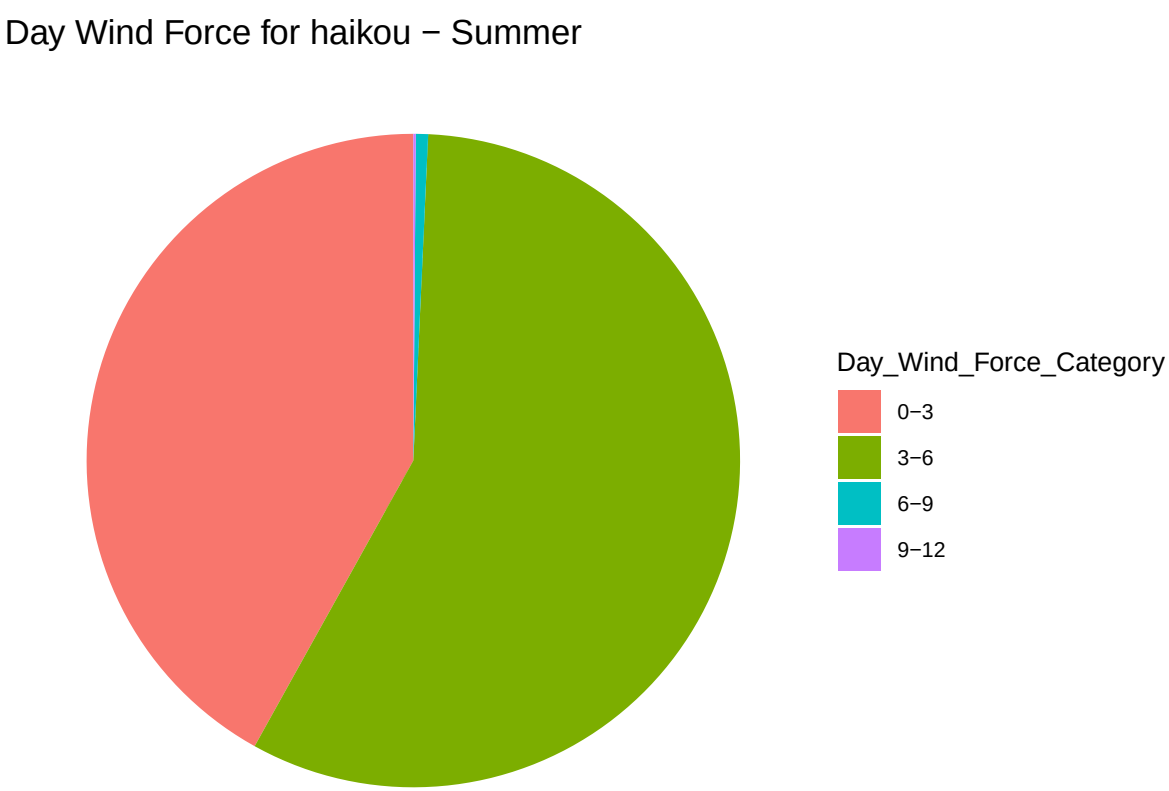
Night Wind Force for haikou − Winter

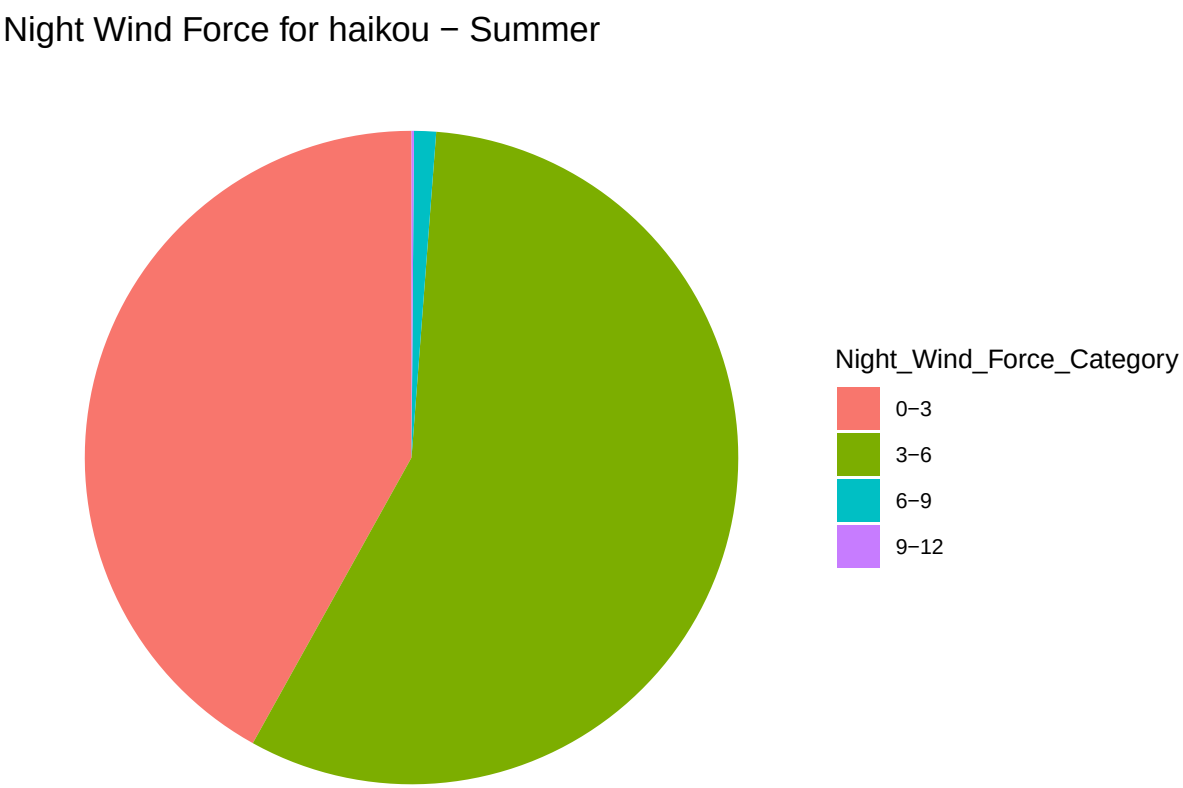


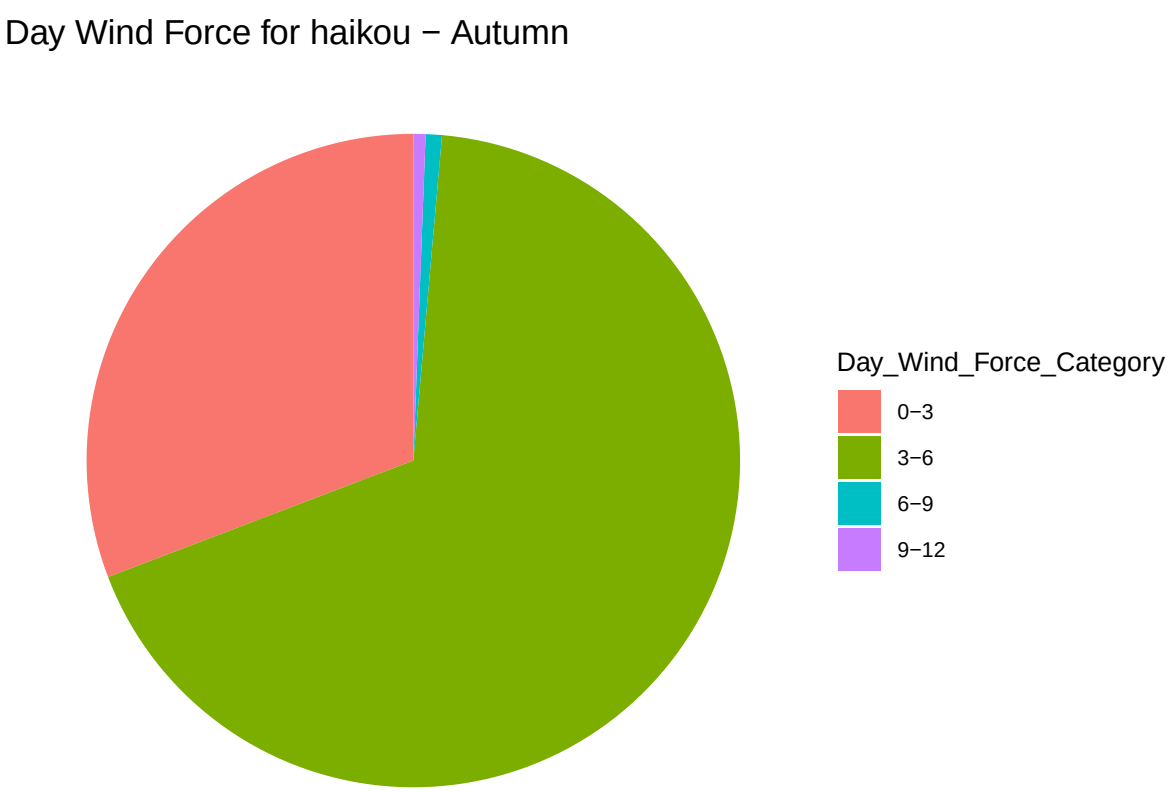

Day Wind Force for haikou − Spring
Day_Wind_Force_Category
0−3
3−6

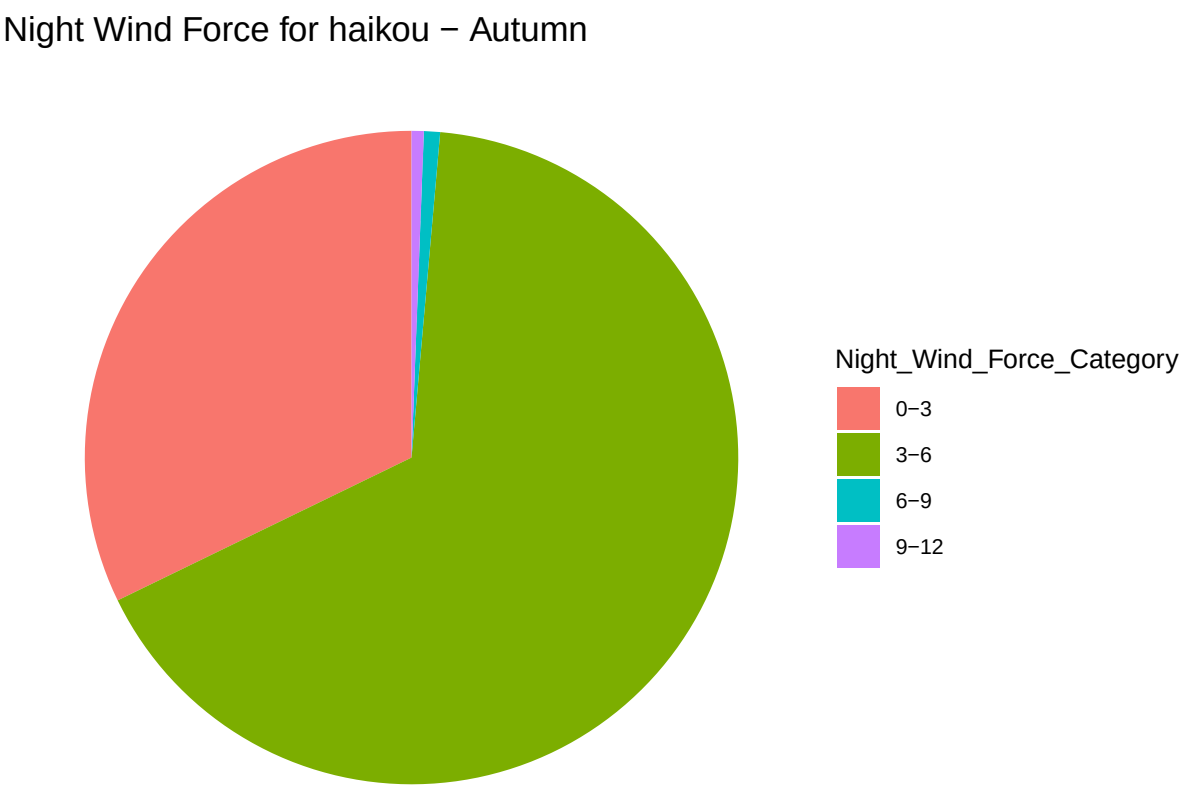
Night Wind Force for haikou − Spring




Day Wind Force for haikou − Summer
Day_Wind_Force_Category
0−3
3−6
6−9
9−12


Night Wind Force for haikou − Summer
Night_Wind_Force_Category
0−3
3−6
6−9
9−12


Day Wind Force for haikou − Autumn
Day_Wind_Force_Category
0−3
3−6
6−9
9−12


Night Wind Force for haikou − Autumn
Night_Wind_Force_Category
0−3
3−6
6−9
9−12