Supply Chain Analysis with R

About Dataset

A DataSet of Supply Chains used by the company DataCo Global was used for the analysis. Dataset of Supply Chain , which allows the use of Machine Learning Algorithms and R Software. Areas of important registered activities : Provisioning , Production , Sales , Commercial Distribution.It also allows the correlation of Structured Data with Unstructured Data for knowledge generation.

Type Data : Structured Data : DataCoSupplyChainDataset.csv Unstructured Data : tokenized_access_logs.csv (Clickstream)

Types of Products : Clothing , Sports , and Electronic Supplies

Additionally it is attached in another file called DescriptionDataCoSupplyChain.csv, the description of each of the variables of the DataCoSupplyChainDatasetc.csv.c.csv.

Initial Exploration

We'll begin by loading the necessary libraries and examining the structure of the dataset to identify important variables and check for missing values.

What we need to know:

- Understand the overall structure of the data.
- Identify any missing values and address them.
- Explore basic statistical summaries of numeric and categorical variables.es.

In [1]:

```r
# Install necessary packages if not already installed
install.packages(c("tidyverse", "skimr", "corrplot", "maps", "ggmap"))
install.packages("gridExtra")
install.packages("plotly")


# Load libraries
library(tidyverse)  # For data manipulation and visualization
library(skimr)      # For quick summary statistics
library(corrplot)   # For correlation matrix
library(scales)  # Load scales package for number formatting
library(plotly)


options(repr.plot.width = 16, repr.plot.height = 12)
options(warn=-1)
```

```
Installing packages into '/usr/local/lib/R/site-library'
(as 'lib' is unspecified)

Installing package into '/usr/local/lib/R/site-library'
(as 'lib' is unspecified)

Installing package into '/usr/local/lib/R/site-library'
(as 'lib' is unspecified)

── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──
✓ dplyr     1.1.4     ✓ readr     2.1.5
✓ forcats   1.0.0     ✓ stringr   1.5.1
✓ ggplot2   3.5.1     ✓ tibble    3.2.1
✓ lubridate 1.9.3     ✓ tidyr     1.3.1
✓ purrr     1.0.2
── 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
corrplot 0.95 loaded


Attaching package: 'scales'


The following object is masked from 'package:purrr':

    discard


The following object is masked from 'package:readr':

    col_factor



Attaching package: 'plotly'


The following object is masked from 'package:ggplot2':

    last_plot


The following object is masked from 'package:stats':

    filter
```

```
The following object is masked from ‘package:graphics’:

    layout

The following object is masked from ‘package:httr’:

    config
```

In [2]:
```
FILL_COLOR <- "#1E3E62"
```

In [3]:
```
# List all files in the directory
list.files("/kaggle/input/dataco-smart-supply-chain-for-big-data-analysis")
```

'DataCoSupplyChainDataset.csv' · 'DescriptionDataCoSupplyChain.csv' · 'tokenized_access_logs.csv'

In [4]:
```
# Reading a CSV file from the directory
data <- read.csv("/kaggle/input/dataco-smart-supply-chain-for-big-data-analysis/DataCoSu

# View the first few rows of the data
head(data)
```

	Type	Days.for.shipping..real.	Days.for.shipment..scheduled.	Benefit.per.order	Sales.per.customer	Delivery.S
	<chr>	<int>	<int>	<dbl>	<dbl>	
1	DEBIT	3	4	91.25	314.64	Ac sh
2	TRANSFER	5	4	-249.09	311.36	Late d
3	CASH	4	4	-247.78	309.72	Shipp
4	DEBIT	3	4	22.86	304.81	Ac sh
5	PAYMENT	2	4	134.21	298.25	Ac sh
6	TRANSFER	6	4	18.58	294.98	Sh ca

In [5]:
```
tail(data)
```

	Type	Days.for.shipping..real.	Days.for.shipment..scheduled.	Benefit.per.order	Sales.per.customer	De
	<chr>	<int>	<int>	<dbl>	<dbl>	
180514	PAYMENT	3	4	119.99	299.99	
180515	CASH	4	4	40.00	399.98	
180516	DEBIT	3	2	-613.77	395.98	La

180517	TRANSFER	5	4	141.11	391.98	La
180518	PAYMENT	3	4	186.23	387.98	
180519	PAYMENT	4	4	168.95	383.98	

In [6]:
```
glimpse(data)
```

```
Rows: 180,519
Columns: 53
$ Type                          <chr> "DEBIT", "TRANSFER", "CASH", "DEBIT", "P…
$ Days.for.shipping..real.      <int> 3, 5, 4, 3, 2, 6, 2, 2, 3, 2, 6, 5, 4, 2…
$ Days.for.shipment..scheduled. <int> 4, 4, 4, 4, 4, 4, 1, 1, 2, 1, 2, 2, 2, 1…
$ Benefit.per.order             <dbl> 91.25, -249.09, -247.78, 22.86, 134.21, …
$ Sales.per.customer            <dbl> 314.64, 311.36, 309.72, 304.81, 298.25, …
$ Delivery.Status               <chr> "Advance shipping", "Late delivery", "Sh…
$ Late_delivery_risk            <int> 0, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1, 1, 1…
$ Category.Id                   <int> 73, 73, 73, 73, 73, 73, 73, 73, 73, 73, …
$ Category.Name                 <chr> "Sporting Goods", "Sporting Goods", "Spo…
$ Customer.City                 <chr> "Caguas", "Caguas", "San Jose", "Los Ang…
$ Customer.Country              <chr> "Puerto Rico", "Puerto Rico", "EE. UU.",…
$ Customer.Email                <chr> "XXXXXXXXX", "XXXXXXXXX", "XXXXXXXXX", "…
$ Customer.Fname                <chr> "Cally", "Irene", "Gillian", "Tana", "Or…
$ Customer.Id                   <int> 20755, 19492, 19491, 19490, 19489, 19488…
$ Customer.Lname                <chr> "Holloway", "Luna", "Maldonado", "Tate",…
$ Customer.Password             <chr> "XXXXXXXXX", "XXXXXXXXX", "XXXXXXXXX", "…
$ Customer.Segment              <chr> "Consumer", "Consumer", "Consumer", "Hom…
$ Customer.State                <chr> "PR", "PR", "CA", "CA", "PR", "NY", "PR"…
$ Customer.Street               <chr> "5365 Noble Nectar Island", "2679 Rustic…
$ Customer.Zipcode              <int> 725, 725, 95125, 90027, 725, 14150, 725,…
$ Department.Id                 <int> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2…
$ Department.Name               <chr> "Fitness", "Fitness", "Fitness", "Fitnes…
$ Latitude                      <dbl> 18.25145, 18.27945, 37.29223, 34.12595, …
$ Longitude                     <dbl> -66.03706, -66.03706, -121.88128, -118.2…
$ Market                        <chr> "Pacific Asia", "Pacific Asia", "Pacific…
$ Order.City                    <chr> "Bekasi", "Bikaner", "Bikaner", "Townsvi…
$ Order.Country                 <chr> "Indonesia", "India", "India", "Australi…
$ Order.Customer.Id             <int> 20755, 19492, 19491, 19490, 19489, 19488…
$ order.date..DateOrders.       <chr> "1/31/2018 22:56", "1/13/2018 12:27", "1…
$ Order.Id                      <int> 77202, 75939, 75938, 75937, 75936, 75935…
$ Order.Item.Cardprod.Id        <int> 1360, 1360, 1360, 1360, 1360, 1360, 1360…
$ Order.Item.Discount           <dbl> 13.11, 16.39, 18.03, 22.94, 29.50, 32.78…
$ Order.Item.Discount.Rate      <dbl> 0.04, 0.05, 0.06, 0.07, 0.09, 0.10, 0.12…
$ Order.Item.Id                 <int> 180517, 179254, 179253, 179252, 179251, …
$ Order.Item.Product.Price      <dbl> 327.75, 327.75, 327.75, 327.75, 327.75, …
$ Order.Item.Profit.Ratio       <dbl> 0.29, -0.80, -0.80, 0.08, 0.45, 0.06, 0.…
$ Order.Item.Quantity           <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1…
$ Sales                         <dbl> 327.75, 327.75, 327.75, 327.75, 327.75, …
$ Order.Item.Total              <dbl> 314.64, 311.36, 309.72, 304.81, 298.25, …
$ Order.Profit.Per.Order        <dbl> 91.25, -249.09, -247.78, 22.86, 134.21, …
$ Order.Region                  <chr> "Southeast Asia", "South Asia", "South A…
$ Order.State                   <chr> "Java Occidental", "Rajast\xe1n", "Rajas…
$ Order.Status                  <chr> "COMPLETE", "PENDING", "CLOSED", "COMPLE…
$ Order.Zipcode                 <int> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, …
$ Product.Card.Id               <int> 1360, 1360, 1360, 1360, 1360, 1360, 1360…
$ Product.Category.Id           <int> 73, 73, 73, 73, 73, 73, 73, 73, 73, 73, …
$ Product.Description           <lgl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, …
$ Product.Image                 <chr> "http://images.acmesports.sports/Smart+w…
$ Product.Name                  <chr> "Smart watch ", "Smart watch ", "Smart w…
```

```
$ Product.Price                <dbl> 327.75, 327.75, 327.75, 327.75, 327.75, …
$ Product.Status               <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0…
$ shipping.date..DateOrders.   <chr> "2/3/2018 22:56", "1/18/2018 12:27", "1/…
$ Shipping.Mode                <chr> "Standard Class", "Standard Class", "Sta…
```

In [7]:
```
df = tibble(data)
```

In [8]:
```
head(df)
```

Type	Days.for.shipping..real.	Days.for.shipment..scheduled.	Benefit.per.order	Sales.per.customer	Delivery.Stat
<chr>	<int>	<int>	<dbl>	<dbl>	<ch
DEBIT	3	4	91.25	314.64	Advar shippi
TRANSFER	5	4	-249.09	311.36	Late delive
CASH	4	4	-247.78	309.72	Shipping ti
DEBIT	3	4	22.86	304.81	Advar shippi
PAYMENT	2	4	134.21	298.25	Advar shippi
TRANSFER	6	4	18.58	294.98	Shippi cancel

In [9]:
```
summary(df)
```

```
    Type           Days.for.shipping..real. Days.for.shipment..scheduled.
Length:180519      Min.   :0.000            Min.   :0.000
Class :character   1st Qu.:2.000            1st Qu.:2.000
Mode  :character   Median :3.000            Median :4.000
                   Mean   :3.498            Mean   :2.932
                   3rd Qu.:5.000            3rd Qu.:4.000
                   Max.   :6.000            Max.   :4.000

 Benefit.per.order  Sales.per.customer Delivery.Status    Late_delivery_risk
 Min.   :-4274.98   Min.   :   7.49    Length:180519      Min.   :0.0000
 1st Qu.:    7.00   1st Qu.: 104.38    Class :character   1st Qu.:0.0000
 Median :   31.52   Median : 163.99    Mode  :character   Median :1.0000
 Mean   :   21.98   Mean   : 183.11                       Mean   :0.5483
 3rd Qu.:   64.80   3rd Qu.: 247.40                       3rd Qu.:1.0000
 Max.   :  911.80   Max.   :1939.99                       Max.   :1.0000

  Category.Id    Category.Name      Customer.City      Customer.Country
 Min.   : 2.00   Length:180519      Length:180519      Length:180519
 1st Qu.:18.00   Class :character   Class :character   Class :character
 Median :29.00   Mode  :character   Mode  :character   Mode  :character
 Mean   :31.85
 3rd Qu.:45.00
 Max.   :76.00

 Customer.Email     Customer.Fname      Customer.Id    Customer.Lname
 Length:180519      Length:180519      Min.   :    1   Length:180519
 Class :character   Class :character   1st Qu.: 3258   Class :character
 Mode  :character   Mode  :character   Median : 6457   Mode  :character
                                       Mean   : 6691
                                       3rd Qu.: 9779
                                       Max.   :20757

 Customer.Password  Customer.Segment   Customer.State     Customer.Street
```

```
Length:180519      Length:180519      Length:180519      Length:180519
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character



Customer.Zipcode Department.Id    Department.Name       Latitude
Min.   :  603    Min.   : 2.000   Length:180519      Min.   :-33.94
1st Qu.:  725    1st Qu.: 4.000   Class :character   1st Qu.: 18.27
Median :19380    Median : 5.000   Mode  :character   Median : 33.14
Mean   :35921    Mean   : 5.443                      Mean   : 29.72
3rd Qu.:78207    3rd Qu.: 7.000                      3rd Qu.: 39.28
Max.   :99205    Max.   :12.000                      Max.   : 48.78
NA's   :3
  Longitude          Market           Order.City        Order.Country
Min.   :-158.03   Length:180519      Length:180519      Length:180519
1st Qu.: -98.45   Class :character   Class :character   Class :character
Median : -76.85   Mode  :character   Mode  :character   Mode  :character
Mean   : -84.92
3rd Qu.: -66.37
Max.   : 115.26

Order.Customer.Id order.date..DateOrders.    Order.Id
Min.   :    1     Length:180519           Min.   :    1
1st Qu.: 3258     Class :character        1st Qu.:18057
Median : 6457     Mode  :character        Median :36140
Mean   : 6691                             Mean   :36222
3rd Qu.: 9779                             3rd Qu.:54144
Max.   :20757                             Max.   :77204

Order.Item.Cardprod.Id Order.Item.Discount Order.Item.Discount.Rate
Min.   :  19.0         Min.   :  0.00      Min.   :0.0000
1st Qu.: 403.0         1st Qu.:  5.40      1st Qu.:0.0400
Median : 627.0         Median : 14.00      Median :0.1000
Mean   : 692.5         Mean   : 20.66      Mean   :0.1017
3rd Qu.:1004.0         3rd Qu.: 29.99      3rd Qu.:0.1600
Max.   :1363.0         Max.   :500.00      Max.   :0.2500

Order.Item.Id    Order.Item.Product.Price Order.Item.Profit.Ratio
Min.   :     1   Min.   :   9.99          Min.   :-2.7500
1st Qu.: 45130   1st Qu.:  50.00          1st Qu.: 0.0800
Median : 90260   Median :  59.99          Median : 0.2700
Mean   : 90260   Mean   : 141.23          Mean   : 0.1206
3rd Qu.:135390   3rd Qu.: 199.99          3rd Qu.: 0.3600
Max.   :180519   Max.   :1999.99          Max.   : 0.5000

Order.Item.Quantity     Sales          Order.Item.Total  Order.Profit.Per.Order
Min.   :1.000       Min.   :   9.99   Min.   :   7.49   Min.   :-4274.98
1st Qu.:1.000       1st Qu.: 119.98   1st Qu.: 104.38   1st Qu.:    7.00
Median :1.000       Median : 199.92   Median : 163.99   Median :   31.52
Mean   :2.128       Mean   : 203.77   Mean   : 183.11   Mean   :   21.98
3rd Qu.:3.000       3rd Qu.: 299.95   3rd Qu.: 247.40   3rd Qu.:   64.80
Max.   :5.000       Max.   :1999.99   Max.   :1939.99   Max.   :  911.80

Order.Region       Order.State        Order.Status       Order.Zipcode
Length:180519      Length:180519      Length:180519      Min.   : 1040
Class :character   Class :character   Class :character   1st Qu.:23464
Mode  :character   Mode  :character   Mode  :character   Median :59405
                                                         Mean   :55426
                                                         3rd Qu.:90008
                                                         Max.   :99301
                                                         NA's   :155679
Product.Card.Id  Product.Category.Id Product.Description Product.Image
Min.   :  19.0   Min.   : 2.00       Mode:logical        Length:180519
1st Qu.: 403.0   1st Qu.:18.00       NA's:180519         Class :character
```

```
 Median : 627.0   Median :29.00                                  Mode   :character
 Mean   : 692.5   Mean   :31.85
 3rd Qu.:1004.0   3rd Qu.:45.00
 Max.   :1363.0   Max.   :76.00

 Product.Name       Product.Price     Product.Status shipping.date..DateOrders.
 Length:180519      Min.   :   9.99   Min.   :0      Length:180519
 Class :character   1st Qu.:  50.00   1st Qu.:0      Class :character
 Mode  :character   Median :  59.99   Median :0      Mode  :character
                    Mean   : 141.23   Mean   :0
                    3rd Qu.: 199.99   3rd Qu.:0
                    Max.   :1999.99   Max.   :0

 Shipping.Mode
 Length:180519
 Class :character
 Mode  :character
```

In [10]:
```
# Total number of missing values in the dataset
sum(is.na(df))
```

336201

In [11]:
```
# Count missing values column-wise
colSums(is.na(df))
```

Type: 0 **Days.for.shipping..real.:** 0 **Days.for.shipment..scheduled.:** 0 **Benefit.per.order:** 0 **Sales.per.customer:** 0 **Delivery.Status:** 0 **Late_delivery_risk:** 0 **Category.Id:** 0 **Category.Name:** 0 **Customer.City:** 0 **Customer.Country:** 0 **Customer.Email:** 0 **Customer.Fname:** 0 **Customer.Id:** 0 **Customer.Lname:** 0 **Customer.Password:** 0 **Customer.Segment:** 0 **Customer.State:** 0 **Customer.Street:** 0 **Customer.Zipcode:** 3 **Department.Id:** 0 **Department.Name:** 0 **Latitude:** 0 **Longitude:** 0 **Market:** 0 **Order.City:** 0 **Order.Country:** 0 **Order.Customer.Id:** 0 **order.date..DateOrders.:** 0 **Order.Id:** 0 **Order.Item.Cardprod.Id:** 0 **Order.Item.Discount:** 0 **Order.Item.Discount.Rate:** 0 **Order.Item.Id:** 0 **Order.Item.Product.Price:** 0 **Order.Item.Profit.Ratio:** 0 **Order.Item.Quantity:** 0 **Sales:** 0 **Order.Item.Total:** 0 **Order.Profit.Per.Order:** 0 **Order.Region:** 0 **Order.State:** 0 **Order.Status:** 0 **Order.Zipcode:** 155679 **Product.Card.Id:** 0 **Product.Category.Id:** 0 **Product.Description:** 180519 **Product.Image:** 0 **Product.Name:** 0 **Product.Price:** 0 **Product.Status:** 0 **shipping.date..DateOrders.:** 0 **Shipping.Mode:** 0

In [12]:
```
print(sum(df$Order.Profit.Per.Order == df$Benefit.per.order))
print(sum(df$Sales == df$Product.Price))
print(sum(df$Order.Item.Product.Price == df$Product.Price))
print(sum(df$Sales.per.customer == df$Order.Item.Total))
print(sum(df$Sales.per.customer == df$Product.Price))

# we can also use cor()
cor(df$Order.Profit.Per.Order, df$Benefit.per.order)
cor(df$Sales, df$Product.Price)
```

```
[1] 180519
[1] 99134
[1] 180519
[1] 180519
[1] 5486
```

1

0.789948201311386

In [13]:
```
# Remove useless columns
```

```
df <- df |>
select(-Customer.Email,
       -Customer.Password,
       -Product.Image,
       -Category.Id,
       -Customer.Fname,
       -Customer.Lname,
       -Customer.Zipcode,
       -Department.Id,
       -Order.Customer.Id,
       -Customer.Id,
       -Order.Id,
       -Order.Item.Cardprod.Id,
       -Order.Item.Id,
       -Order.Zipcode,
       -Product.Card.Id,
       -Product.Category.Id,
       -Product.Description,
       -Order.Item.Product.Price,
       -Order.Item.Total,
       -Benefit.per.order)
```

In [14]:
```
glimpse(df)
```

```
Rows: 180,519
Columns: 33
$ Type                          <chr> "DEBIT", "TRANSFER", "CASH", "DEBIT", "P…
$ Days.for.shipping..real.      <int> 3, 5, 4, 3, 2, 6, 2, 2, 3, 2, 6, 5, 4, 2…
$ Days.for.shipment..scheduled. <int> 4, 4, 4, 4, 4, 4, 1, 1, 2, 1, 2, 2, 2, 1…
$ Sales.per.customer            <dbl> 314.64, 311.36, 309.72, 304.81, 298.25, …
$ Delivery.Status               <chr> "Advance shipping", "Late delivery", "Sh…
$ Late_delivery_risk            <int> 0, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1, 1, 1…
$ Category.Name                 <chr> "Sporting Goods", "Sporting Goods", "Spo…
$ Customer.City                 <chr> "Caguas", "Caguas", "San Jose", "Los Ang…
$ Customer.Country              <chr> "Puerto Rico", "Puerto Rico", "EE. UU.",…
$ Customer.Segment              <chr> "Consumer", "Consumer", "Consumer", "Hom…
$ Customer.State                <chr> "PR", "PR", "CA", "CA", "PR", "NY", "PR"…
$ Customer.Street               <chr> "5365 Noble Nectar Island", "2679 Rustic…
$ Department.Name               <chr> "Fitness", "Fitness", "Fitness", "Fitnes…
$ Latitude                      <dbl> 18.25145, 18.27945, 37.29223, 34.12595, …
$ Longitude                     <dbl> -66.03706, -66.03706, -121.88128, -118.2…
$ Market                        <chr> "Pacific Asia", "Pacific Asia", "Pacific…
$ Order.City                    <chr> "Bekasi", "Bikaner", "Bikaner", "Townsvi…
$ Order.Country                 <chr> "Indonesia", "India", "India", "Australi…
$ order.date..DateOrders.       <chr> "1/31/2018 22:56", "1/13/2018 12:27", "1…
$ Order.Item.Discount           <dbl> 13.11, 16.39, 18.03, 22.94, 29.50, 32.78…
$ Order.Item.Discount.Rate      <dbl> 0.04, 0.05, 0.06, 0.07, 0.09, 0.10, 0.12…
$ Order.Item.Profit.Ratio       <dbl> 0.29, -0.80, -0.80, 0.08, 0.45, 0.06, 0.…
$ Order.Item.Quantity           <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1…
$ Sales                         <dbl> 327.75, 327.75, 327.75, 327.75, 327.75, …
$ Order.Profit.Per.Order        <dbl> 91.25, -249.09, -247.78, 22.86, 134.21, …
$ Order.Region                  <chr> "Southeast Asia", "South Asia", "South A…
$ Order.State                   <chr> "Java Occidental", "Rajast\xe1n", "Rajas…
$ Order.Status                  <chr> "COMPLETE", "PENDING", "CLOSED", "COMPLE…
$ Product.Name                  <chr> "Smart watch ", "Smart watch ", "Smart w…
$ Product.Price                 <dbl> 327.75, 327.75, 327.75, 327.75, 327.75, …
$ Product.Status                <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0…
$ shipping.date..DateOrders.    <chr> "2/3/2018 22:56", "1/18/2018 12:27", "1/…
$ Shipping.Mode                 <chr> "Standard Class", "Standard Class", "Sta…
```

In [15]:
```
sum(is.na(df))
```

0

In [16]:
```
# Count missing values column-wise
```

```
colSums(is.na(df))
```

Type: 0 **Days.for.shipping..real.:** 0 **Days.for.shipment..scheduled.:** 0 **Sales.per.customer:** 0 **Delivery.Status:** 0 **Late_delivery_risk:** 0 **Category.Name:** 0 **Customer.City:** 0 **Customer.Country:** 0 **Customer.Segment:** 0 **Customer.State:** 0 **Customer.Street:** 0 **Department.Name:** 0 **Latitude:** 0 **Longitude:** 0 **Market:** 0 **Order.City:** 0 **Order.Country:** 0 **order.date..DateOrders.:** 0 **Order.Item.Discount:** 0 **Order.Item.Discount.Rate:** 0 **Order.Item.Profit.Ratio:** 0 **Order.Item.Quantity:** 0 **Sales:** 0 **Order.Profit.Per.Order:** 0 **Order.Region:** 0 **Order.State:** 0 **Order.Status:** 0 **Product.Name:** 0 **Product.Price:** 0 **Product.Status:** 0 **shipping.date..DateOrders.:** 0 **Shipping.Mode:** 0

In [17]:
```
# Identify duplicate
duplicates <- duplicated(df)
```

In [18]:
```
# View duplicate
df[duplicates, ]
```

Type	Days.for.shipping..real.	Days.for.shipment..scheduled.	Sales.per.customer	Delivery.Status	Late_delivery_risk
<chr>	<int>	<int>	<dbl>	<chr>	<int>

In [19]:
```
# Count the number of duplicate
sum(duplicates)
```

0

In [20]:
```
# Removing duplicates if any
df <- distinct(df)
```

Date transformation and calculate shipping duration

We'll convert **order.date..DateOrders**. and **shipping.date..DateOrders**. into a proper Date format and calculate the shipping duration (in days). Finally, we'll analyze the shipping duration to understand delivery trends.

What we need to know:

- How long does it take to ship an order?
- Explore any delay patterns in shipping compared to the scheduled time.

Summary:

- Date columns have been converted for analysis.
- Shipping duration is now calculated for further exploration.tion.

In [21]:
```
# Convert date columns and calculate shipping duration
df$order_date <- mdy_hms(df$order.date..DateOrders.)
df$shipping_date <- mdy_hms(df$shipping.date..DateOrders.)

# Calculate shipping duration
df$shipping_duration <- as.numeric(difftime(df$shipping_date, df$order_date, units = "da
```

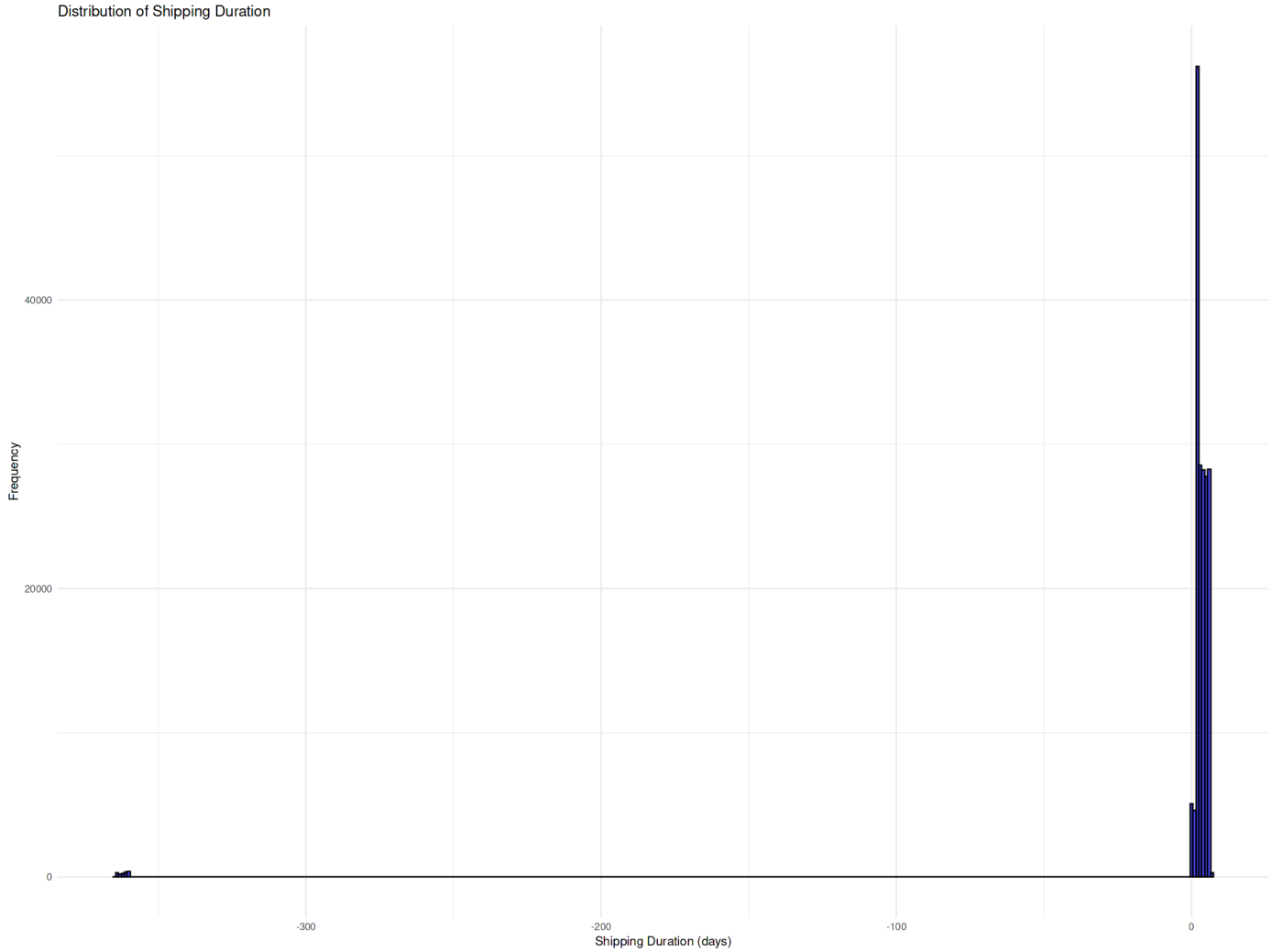
In [22]:
```
# Summary statistics of shipping duration
summary(df$shipping_duration)
```

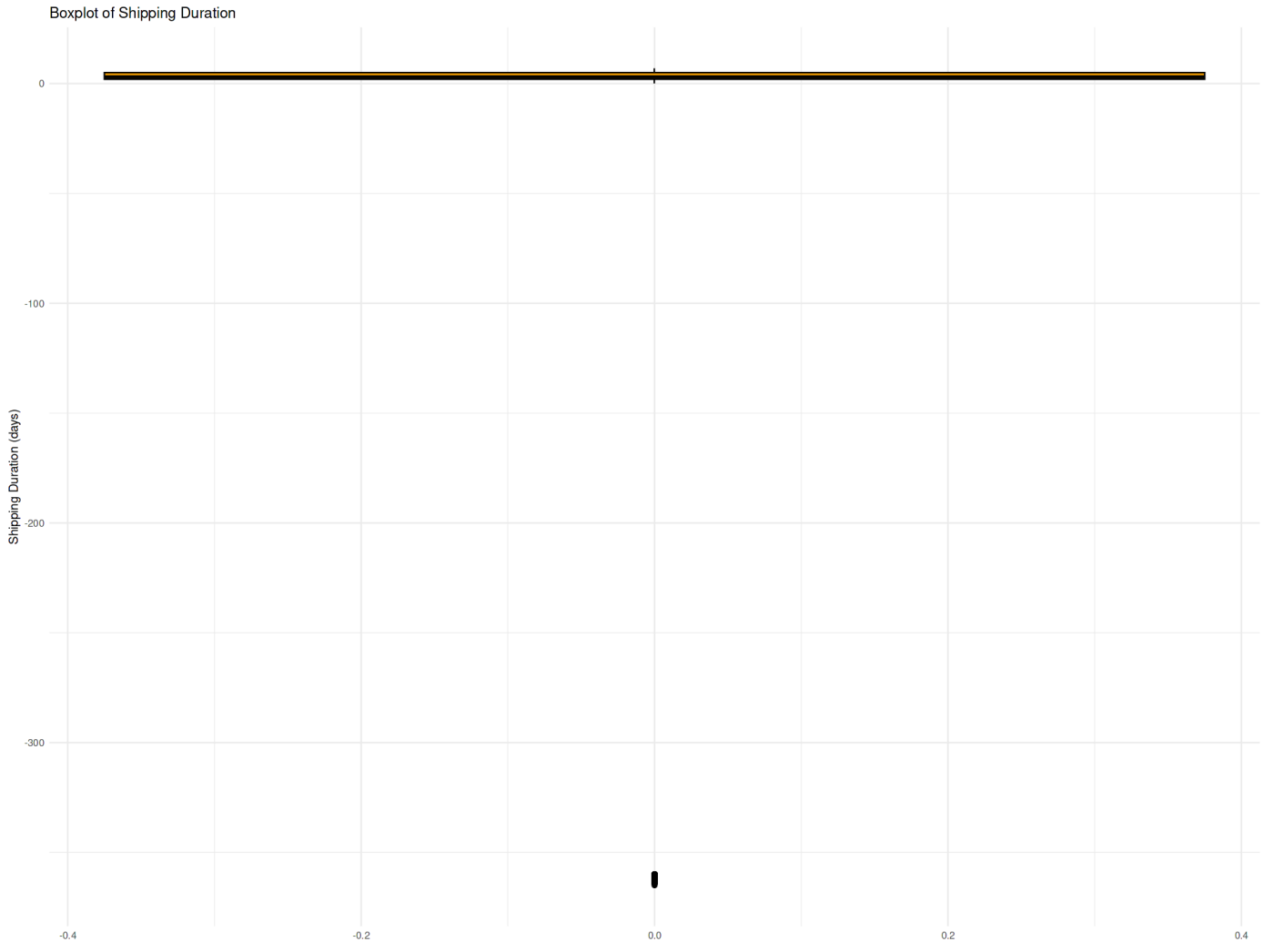
```
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-364.9667    2.0000    3.0000    0.4836    5.0000    7.0000
```

In [23]:
```
# Find rows with negative or NA shipping durations
anomalies <- df %>% filter(is.na(shipping_duration) | shipping_duration < 0)
print(anomalies)
```

```
# A tibble: 1,490 × 36
   Type     Days.for.shipping..real. Days.for.shipment..sch…¹ Sales.per.customer
   <chr>                       <int>                    <int>              <dbl>
 1 PAYMENT                         5                        2               87
 2 TRANSFER                        6                        4              200
 3 DEBIT                           3                        4              123.
 4 DEBIT                           6                        4              197.
 5 PAYMENT                         5                        2              255.
 6 PAYMENT                         5                        2              192
 7 TRANSFER                        5                        4              230.
 8 DEBIT                           5                        4              118.
 9 DEBIT                           5                        4              117.
10 DEBIT                           4                        4              113.
# ℹ 1,480 more rows
# ℹ abbreviated name: ¹Days.for.shipment..scheduled.
# ℹ 32 more variables: Delivery.Status <chr>, Late_delivery_risk <int>,
#   Category.Name <chr>, Customer.City <chr>, Customer.Country <chr>,
#   Customer.Segment <chr>, Customer.State <chr>, Customer.Street <chr>,
#   Department.Name <chr>, Latitude <dbl>, Longitude <dbl>, Market <chr>,
#   Order.City <chr>, Order.Country <chr>, order.date..DateOrders. <chr>, …
```

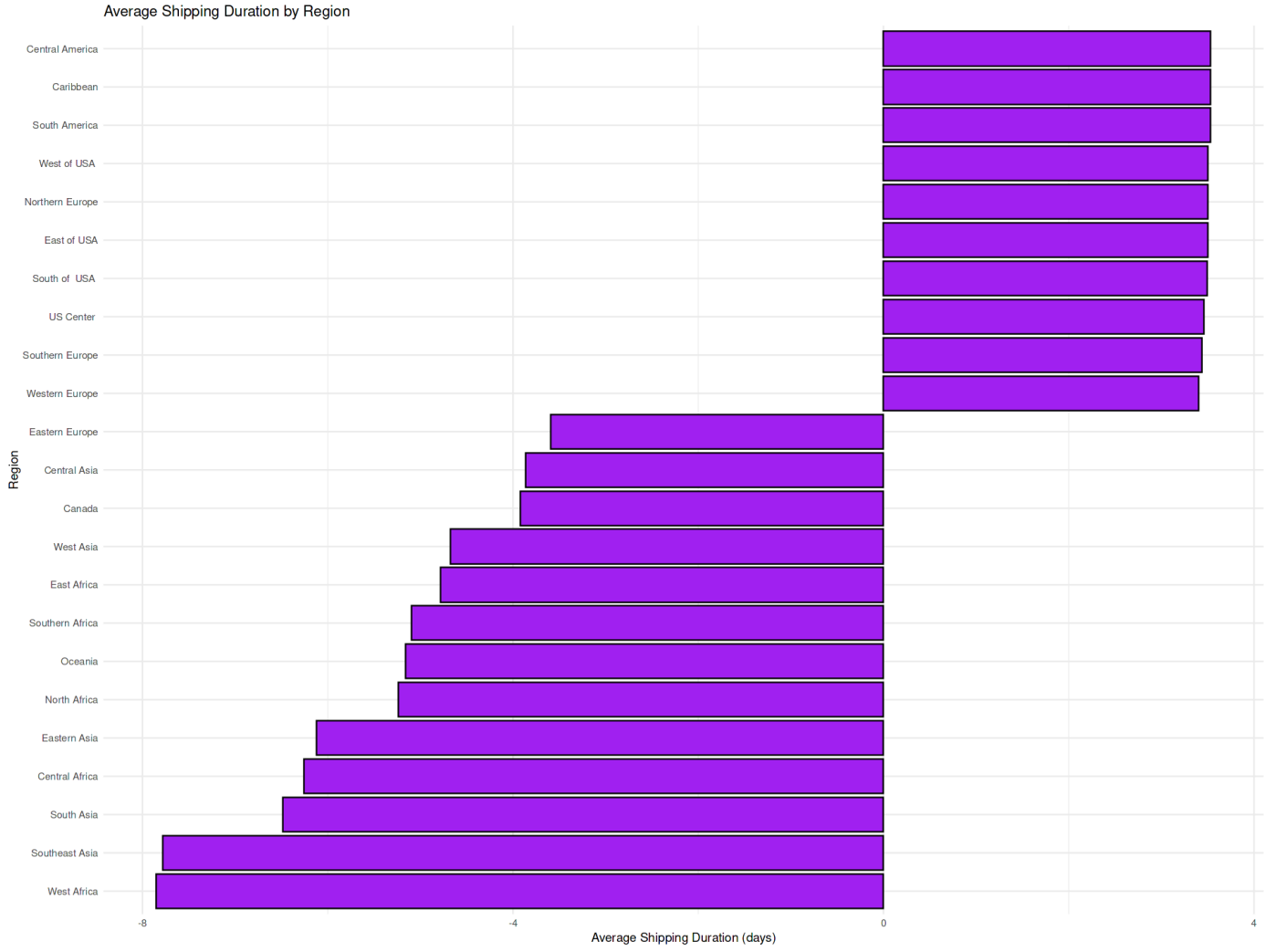
In [24]:
```
# Load ggplot2 for visualization
library(ggplot2)

# Histogram of shipping duration
ggplot(df, aes(x = shipping_duration)) +
  geom_histogram(binwidth = 1, fill = "blue", color = "black", alpha = 0.7) +
  labs(title = "Distribution of Shipping Duration", x = "Shipping Duration (days)", y =
  theme_minimal()

# Boxplot of shipping duration
ggplot(df, aes(y = shipping_duration)) +
  geom_boxplot(fill = "orange", color = "black") +
  labs(title = "Boxplot of Shipping Duration", y = "Shipping Duration (days)") +
  theme_minimal()
```


Distribution of Shipping Duration
Frequency
40000
20000
0
-300
-200
-100
0
Shipping Duration (days)


Boxplot of Shipping Duration
Shipping Duration (days)
0
-100
-200
-300
-0.4
-0.2
0.0
0.2
0.4

In [25]:
```r
# Average shipping duration by region
region_shipping <- df %>%
  group_by(Order.Region) %>%
  summarise(avg_shipping_duration = mean(shipping_duration, na.rm = TRUE))

print(region_shipping)

# Plot average shipping duration by region
ggplot(region_shipping, aes(x = reorder(Order.Region, avg_shipping_duration), y = avg_sh
  geom_bar(stat = "identity", fill = "purple", color = "black") +
  labs(title = "Average Shipping Duration by Region", x = "Region", y = "Average Shippin
  theme_minimal() +
  coord_flip()
```

```
# A tibble: 23 × 2
   Order.Region    avg_shipping_duration
   <chr>                           <dbl>
 1 Canada                          -3.92
 2 Caribbean                        3.53
 3 Central Africa                  -6.26
 4 Central America                  3.53
 5 Central Asia                    -3.86
 6 East Africa                     -4.78
 7 East of USA                      3.50
 8 Eastern Asia                    -6.12
 9 Eastern Europe                  -3.59
10 North Africa                    -5.24
# ℹ 13 more rows
```



In [26]:
```r
# Convert Product.Status to a factor for better labeling in the plot
df$Product.Status <- factor(df$Product.Status, levels = c(0, 1), labels = c("Available",
```

Explore Categorical Variables

We will analyze the distribution of important categorical variables like **Type**, **Delivery.Status**, and **Shipping.Mode** to understand the nature of the transactions and deliveries.

What we need to know:

- What types of transactions are most common?
- What are the most frequent delivery statuses and shipping modes?

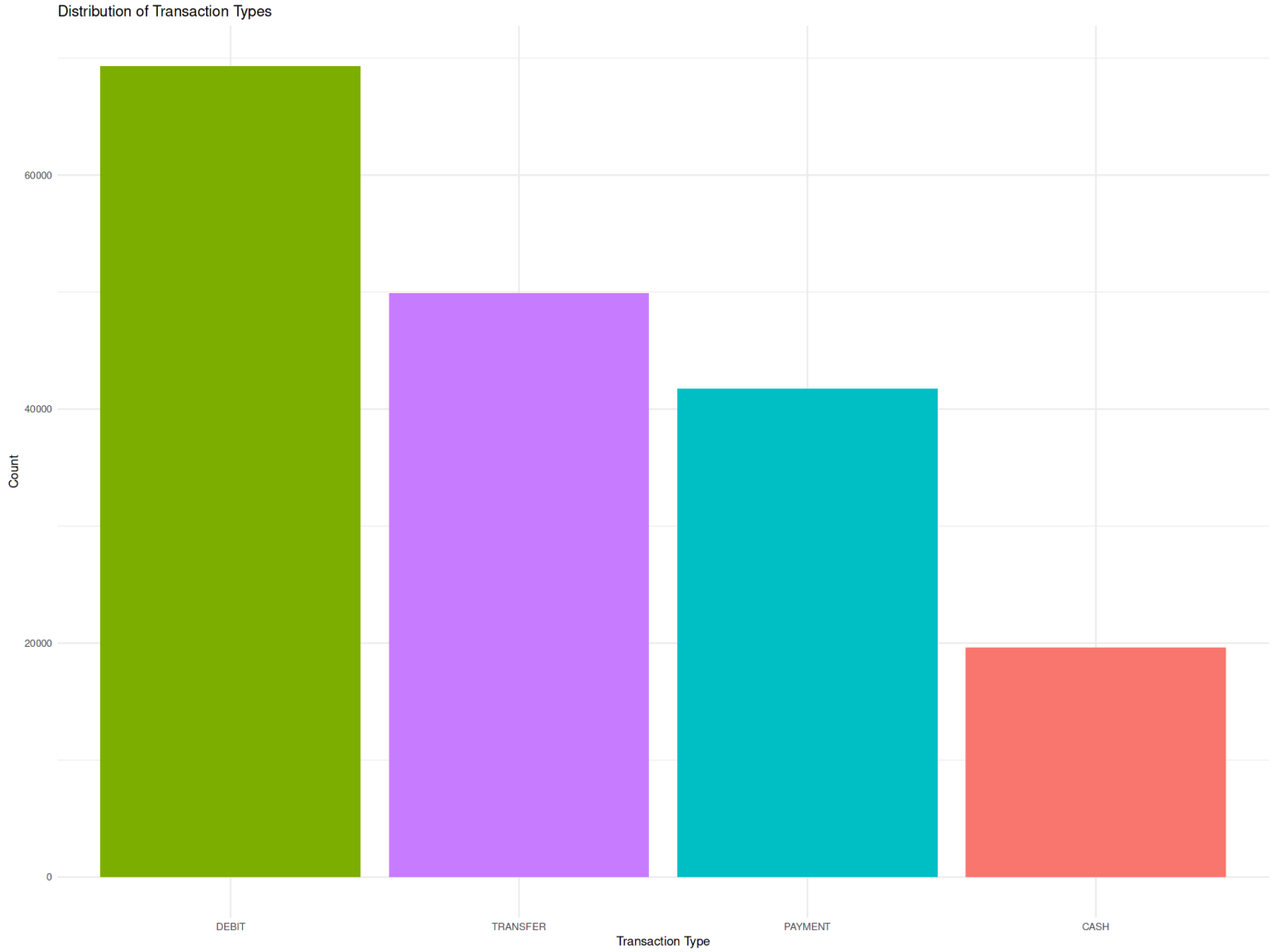
Summary:

- Most transactions are of type "DEBIT".
- Delivery status is mostly in "Late delivery."
- "Standard Class" is the most common shipping mode.

Summarize and visualize the distribution of transaction types.

In [27]:
```
# Summary of transaction types
type_summary <- df %>%
  group_by(Type) %>%
  summarise(count = n()) %>%
  mutate(percentage = round((count / sum(count)) * 100, 2))

print(type_summary)

# Bar plot for transaction types
ggplot(type_summary, aes(x = reorder(Type, -count), y = count, fill = Type)) +
  geom_bar(stat = "identity", show.legend = FALSE) +
  labs(title = "Distribution of Transaction Types", x = "Transaction Type", y = "Count") +
  theme_minimal()
```

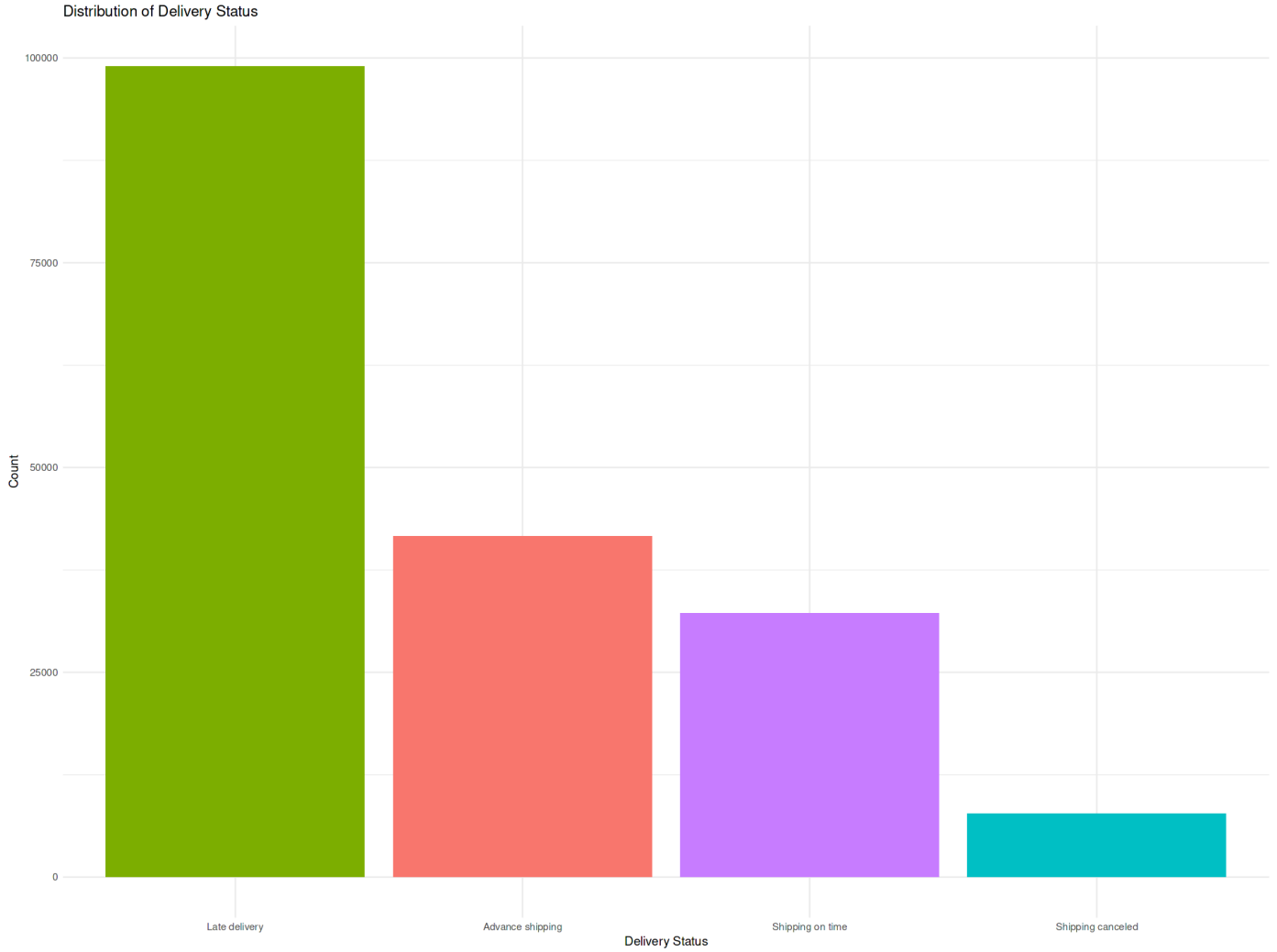
```
# A tibble: 4 × 3
  Type     count percentage
  <chr>    <int>      <dbl>
1 CASH     19616       10.9
2 DEBIT    69295       38.4
3 PAYMENT  41725       23.1
4 TRANSFER 49883       27.6
```



Analyze the most frequent delivery statuses.

In [28]:
```
# Summary of delivery status
delivery_status_summary <- df %>%
  group_by(Delivery.Status) %>%
  summarise(count = n()) %>%
  mutate(percentage = round((count / sum(count)) * 100, 2))

print(delivery_status_summary)

# Bar plot for delivery status
ggplot(delivery_status_summary, aes(x = reorder(Delivery.Status, -count), y = count, fil
  geom_bar(stat = "identity", show.legend = FALSE) +
  labs(title = "Distribution of Delivery Status", x = "Delivery Status", y = "Count") +
  theme_minimal()
```

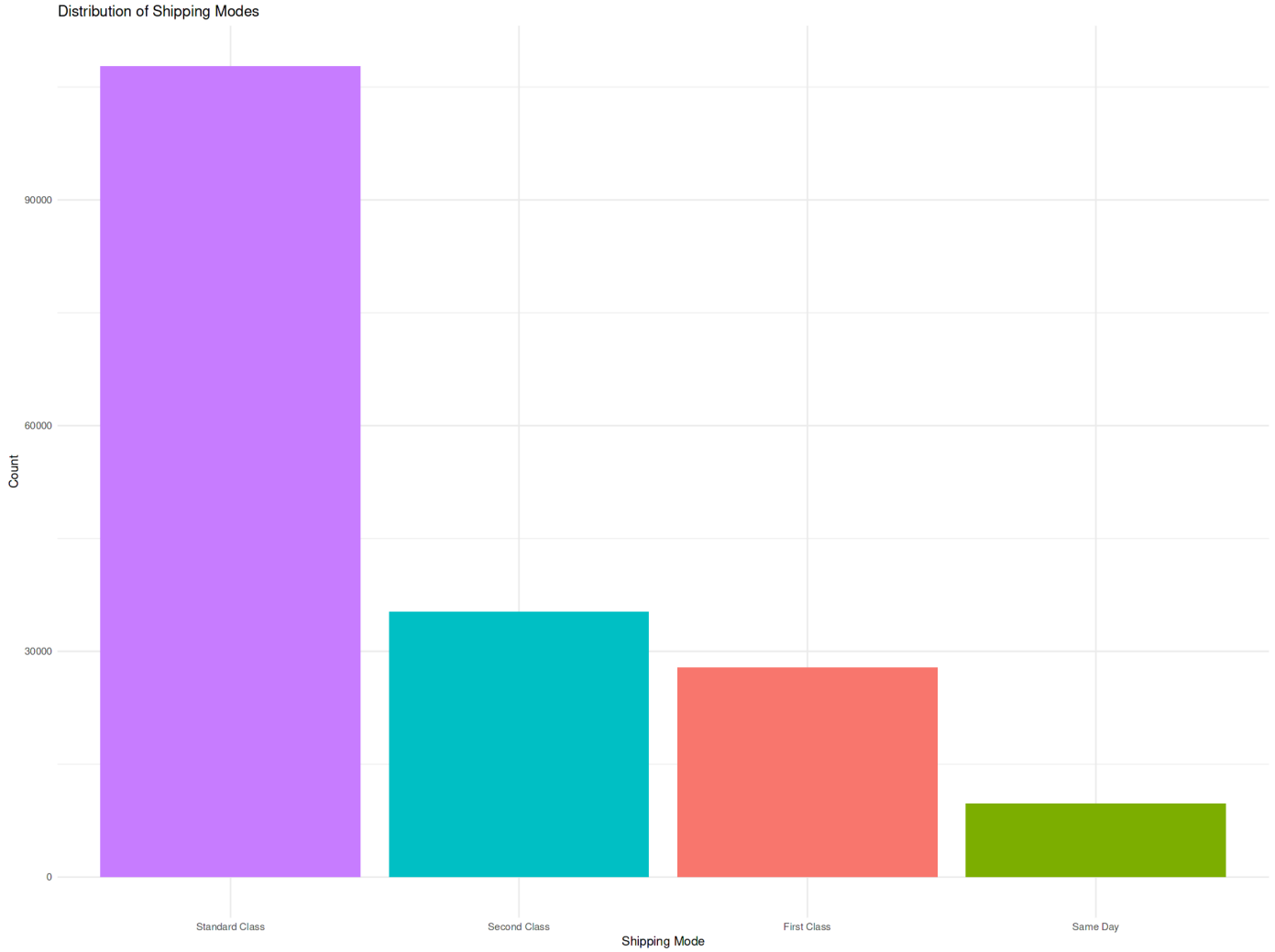
```
# A tibble: 4 × 3
  Delivery.Status   count percentage
  <chr>             <int>      <dbl>
1 Advance shipping  41592       23.0
2 Late delivery     98977       54.8
3 Shipping canceled  7754        4.3
4 Shipping on time  32196       17.8
```



Understand the most frequent shipping modes.

In [29]:
```
# Summary of shipping modes
shipping_mode_summary <- data %>%
  group_by(Shipping.Mode) %>%
  summarise(count = n()) %>%
  mutate(percentage = round((count / sum(count)) * 100, 2))

print(shipping_mode_summary)

# Bar plot for shipping modes
ggplot(shipping_mode_summary, aes(x = reorder(Shipping.Mode, -count), y = count, fill =
  geom_bar(stat = "identity", show.legend = FALSE) +
  labs(title = "Distribution of Shipping Modes", x = "Shipping Mode", y = "Count") +
  theme_minimal()
```

```
# A tibble: 4 × 3
  Shipping.Mode   count percentage
  <chr>           <int>      <dbl>
1 First Class     27814      15.4
2 Same Day         9737       5.39
3 Second Class    35216      19.5
4 Standard Class 107752      59.7
```



Summary Statistics for Numeric Columns

Next, we will generate summary statistics for numeric variables, such as Benefit.per.order, Sales.per.customer, and Order.Item.Discount.

We need to know:

- What are the ranges and typical values for these numeric variables?
- Are there any interesting patterns in the benefit per order and sales per costomer?

Summary:

- Most benefits per order are positive, but there are outliers with negative benefits.
- Sales per customer vary widely, with some customers generating significantly higher sales.

In [30]:
```
# Summary statistics for numeric variables
df %>%
  select(Order.Profit.Per.Order, Sales.per.customer, Order.Item.Discount) %>%
  summary()
```

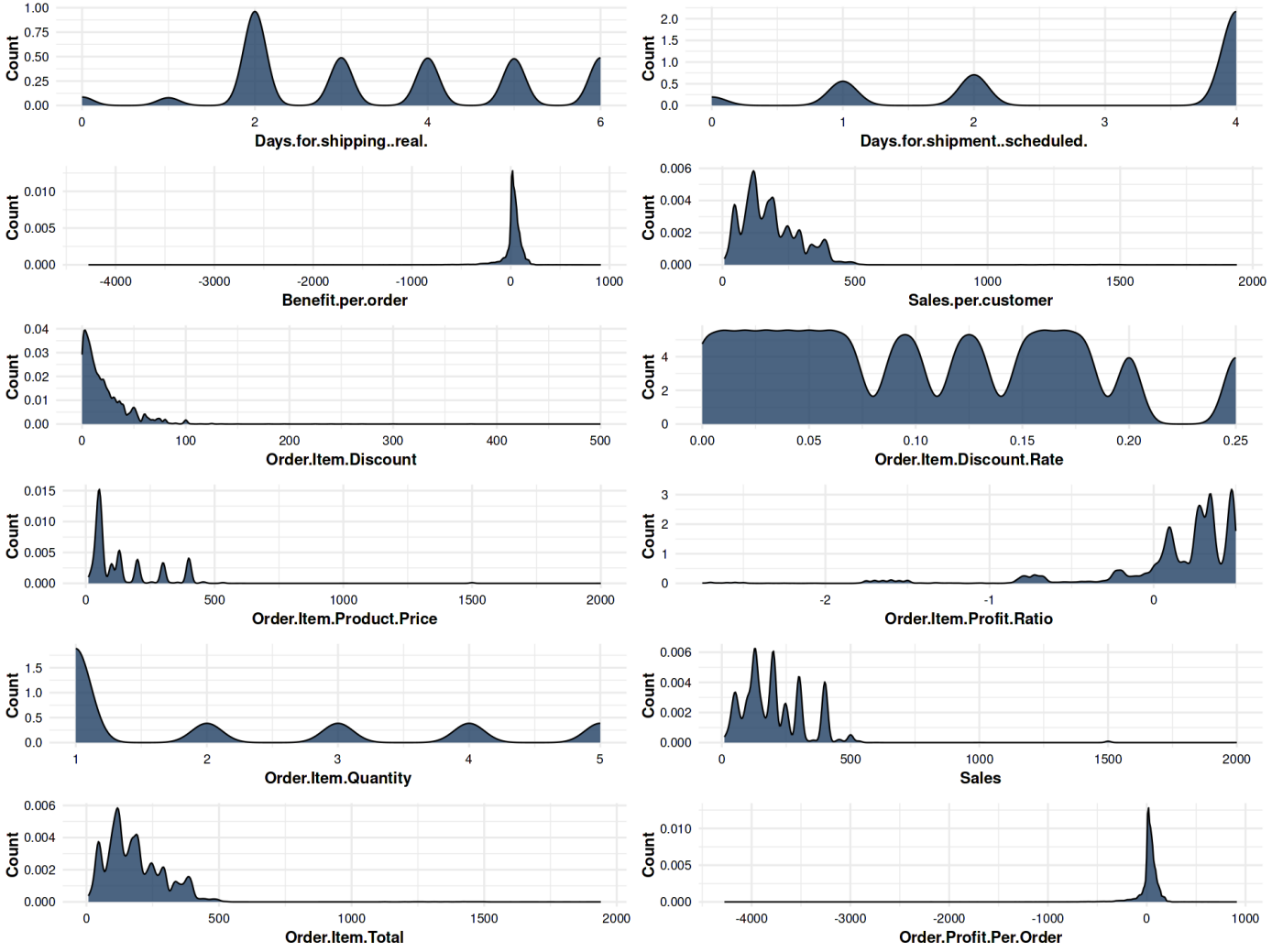
```
 Order.Profit.Per.Order Sales.per.customer Order.Item.Discount
 Min.   :-4274.98       Min.   :   7.49    Min.   :  0.00
 1st Qu.:    7.00       1st Qu.: 104.38    1st Qu.:  5.40
 Median :   31.52       Median : 163.99    Median : 14.00
 Mean   :   21.98       Mean   : 183.11    Mean   : 20.66
```

```
 3rd Qu.:   64.80       3rd Qu.: 247.40    3rd Qu.: 29.99
 Max.   :  911.80       Max.   :1939.99    Max.   :500.00
```

In [31]:

```r
library(gridExtra)

# Selecting the numeric columns from the dataset
numeric_vars <- data %>%
  select(Days.for.shipping..real., Days.for.shipment..scheduled., Benefit.per.order,
         Sales.per.customer, Order.Item.Discount, Order.Item.Discount.Rate,
         Order.Item.Product.Price, Order.Item.Profit.Ratio, Order.Item.Quantity,
         Sales, Order.Item.Total, Order.Profit.Per.Order)

# Create a list to store histogram plots
hist_plots <- list()

# Loop through numeric variables and create histograms
for (var in colnames(numeric_vars)) {
  hist_plots[[var]] <- ggplot(data, aes_string(x = var)) +
    geom_density(fill = FILL_COLOR, alpha = 0.8) +
    labs(x = var,
         y = "Count") +
    theme_minimal(base_size = 14) +
    theme(plot.title = element_text(hjust = 0.5, face = "bold", size = 16),
          axis.title.x = element_text(face = "bold"),
          axis.title.y = element_text(face = "bold"),
          axis.text = element_text(color = "black"))
}

# Arrange histograms side by side
grid.arrange(grobs = hist_plots, ncol = 2)  # Change ncol to adjust the number of column
```

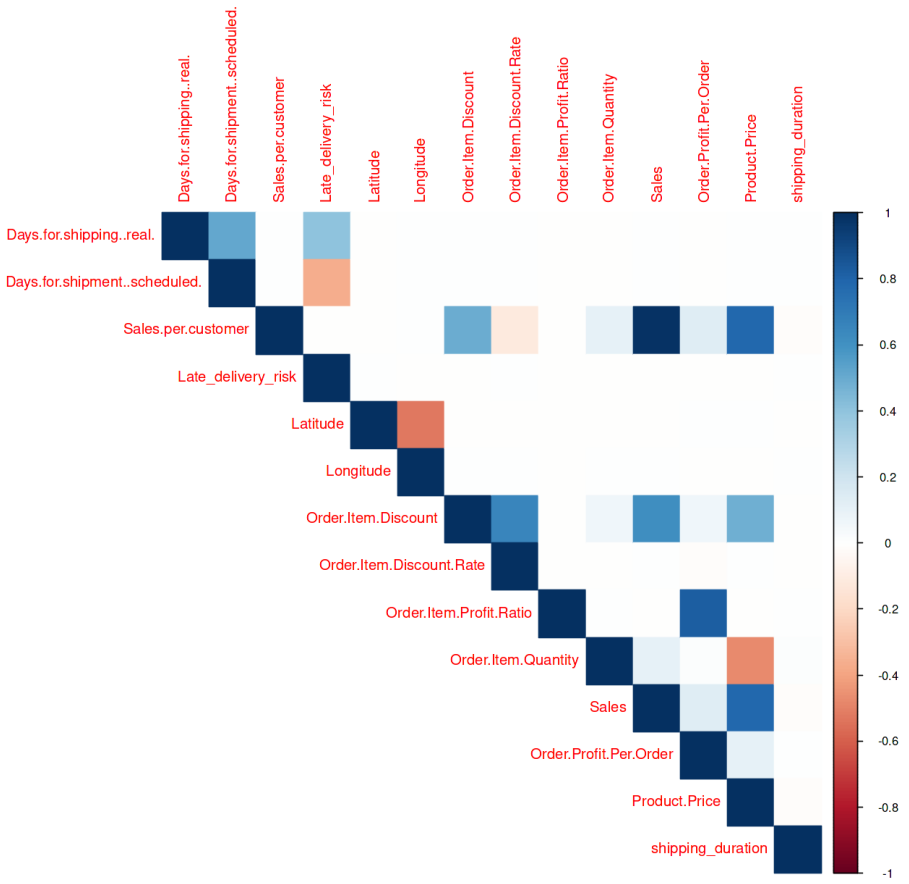
```
Attaching package: ‘gridExtra’


The following object is masked from ‘package:dplyr’:

    combine
```



Exploring Correlations Between Numeric Variables

We will explore the correlations between numeric variables to identify relationships. This will help understand how variables such as Benefit.per.order and Sales.per.customer are related.

In [32]:
```r
# Select numeric columns
numeric_cols <- df %>%
select_if(is.numeric)

# compute the correlation matrix
cor_matrix <- cor(numeric_cols, use="complete.obs")

# plot the correlation matrix
corrplot(cor_matrix,method ="color", type = "upper", t1.cex = 0.8)
```

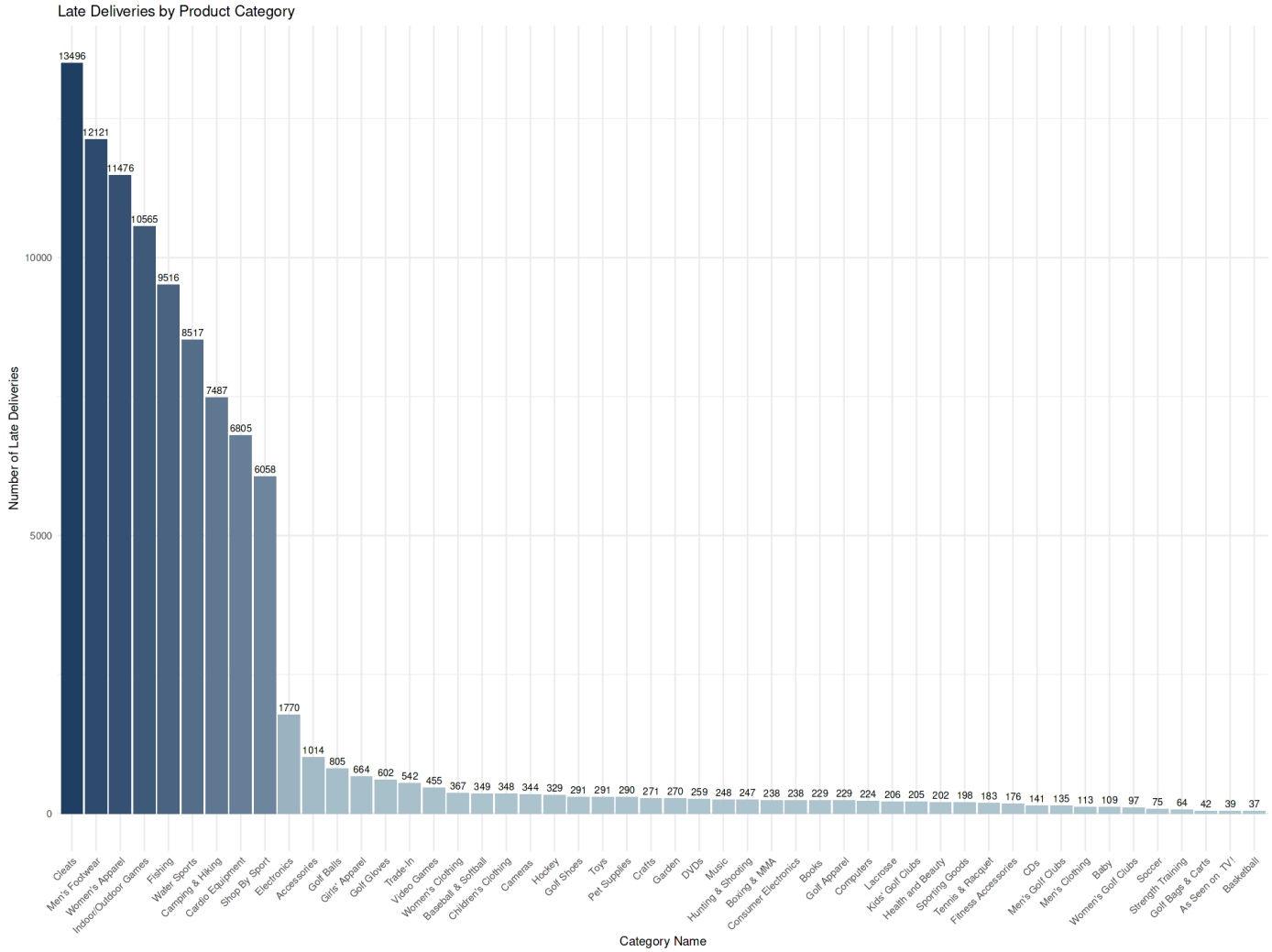


Lets Q/A some business questions

1. **Which category has the most frequent late deliveries?**

In [33]:

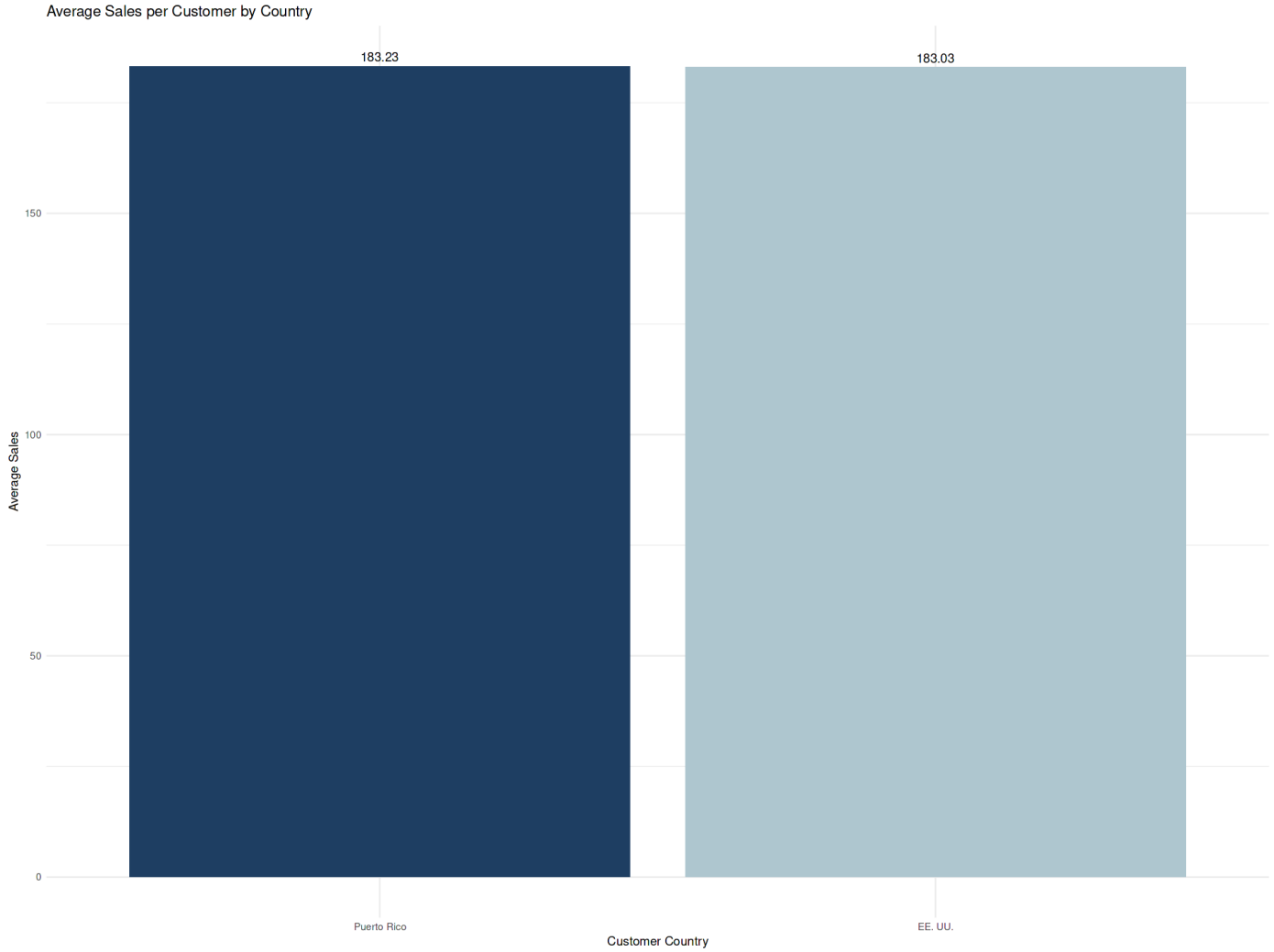
```
# Summarizing late deliveries by category
category_late_deliveries <- df %>%
  group_by(Category.Name) %>%
  summarise(late_count = sum(Late_delivery_risk == 1, na.rm = TRUE))

# Plotting the data with a heatmap effect
ggplot(category_late_deliveries, aes(x = reorder(Category.Name, -late_count), y = late_c
  geom_bar(stat = "identity") +
  geom_text(aes(label = late_count), vjust = -0.5, size = 3) +  # Adjust text size
  labs(title = "Late Deliveries by Product Category",
       y = "Number of Late Deliveries",
       x = "Category Name") +
  scale_fill_gradient(low = "#AEC6CF", high = "#1E3E62") +  # Heatmap effect with gradie
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) +  # Rotate x-axis labels
  theme(legend.position = "none")
```



- Answer: **Cleats**, **Men's footwear**, **Women's Apparel** etc.. has the most frequent late deliveries.

1. **Which countries have the highest average sales per customer?**

In [34]:
```
# Summarizing average sales by country
sales_by_country <- df %>%
  group_by(Customer.Country) %>%
  summarise(avg_sales = mean(Sales.per.customer, na.rm = TRUE))

# Plotting the data with a heatmap effect
ggplot(sales_by_country, aes(x = reorder(Customer.Country, -avg_sales), y = avg_sales, f
  geom_bar(stat = "identity") +
  geom_text(aes(label = round(avg_sales, 2)), vjust = -0.5) +
  labs(title = "Average Sales per Customer by Country", y = "Average Sales", x = "Custom
  scale_fill_gradient(low = "#AEC6CF", high = "#1E3E62") +  # Heatmap effect with gradie
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) +
  theme_minimal() +
  theme(legend.position = "none")
```



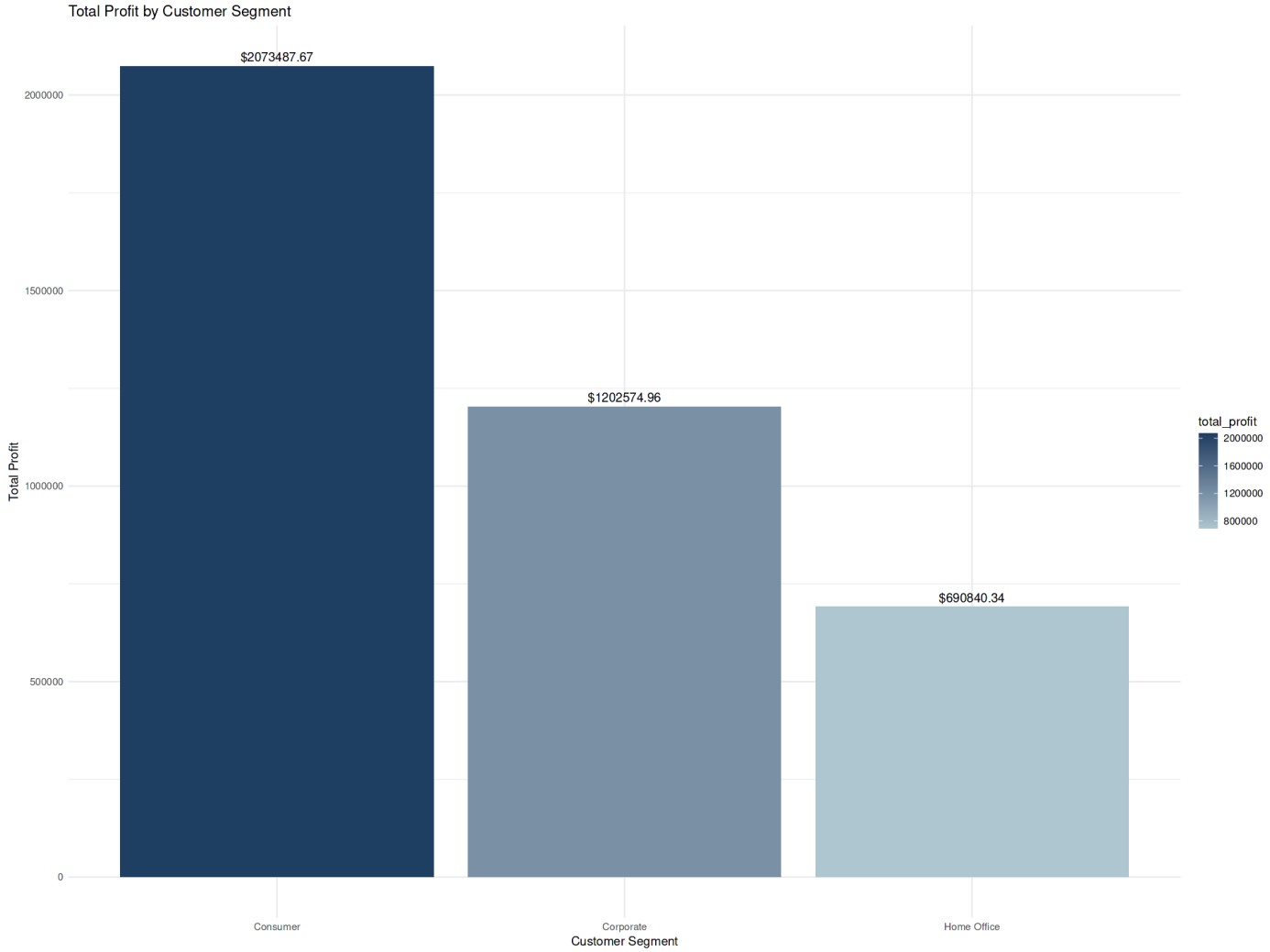
- Answer: I think there is one country **EE. UU. EE UU** is the Spanish acronym for **Estados Unidos** or **United States** and **Puerto Rico** is a **Caribbean island** and unincorporated U.S. territory with a landscape of mountains,. Spanish often doubles the letters to indicate a plural acronym. And they almost equal.

Customer Analysis

Customer analysis is a critical component in understanding business performance and making informed decisions. It involves examining customer behavior, segmentation, profitability, and preferences.

1. **Which customer segment contributes the most to profit?**

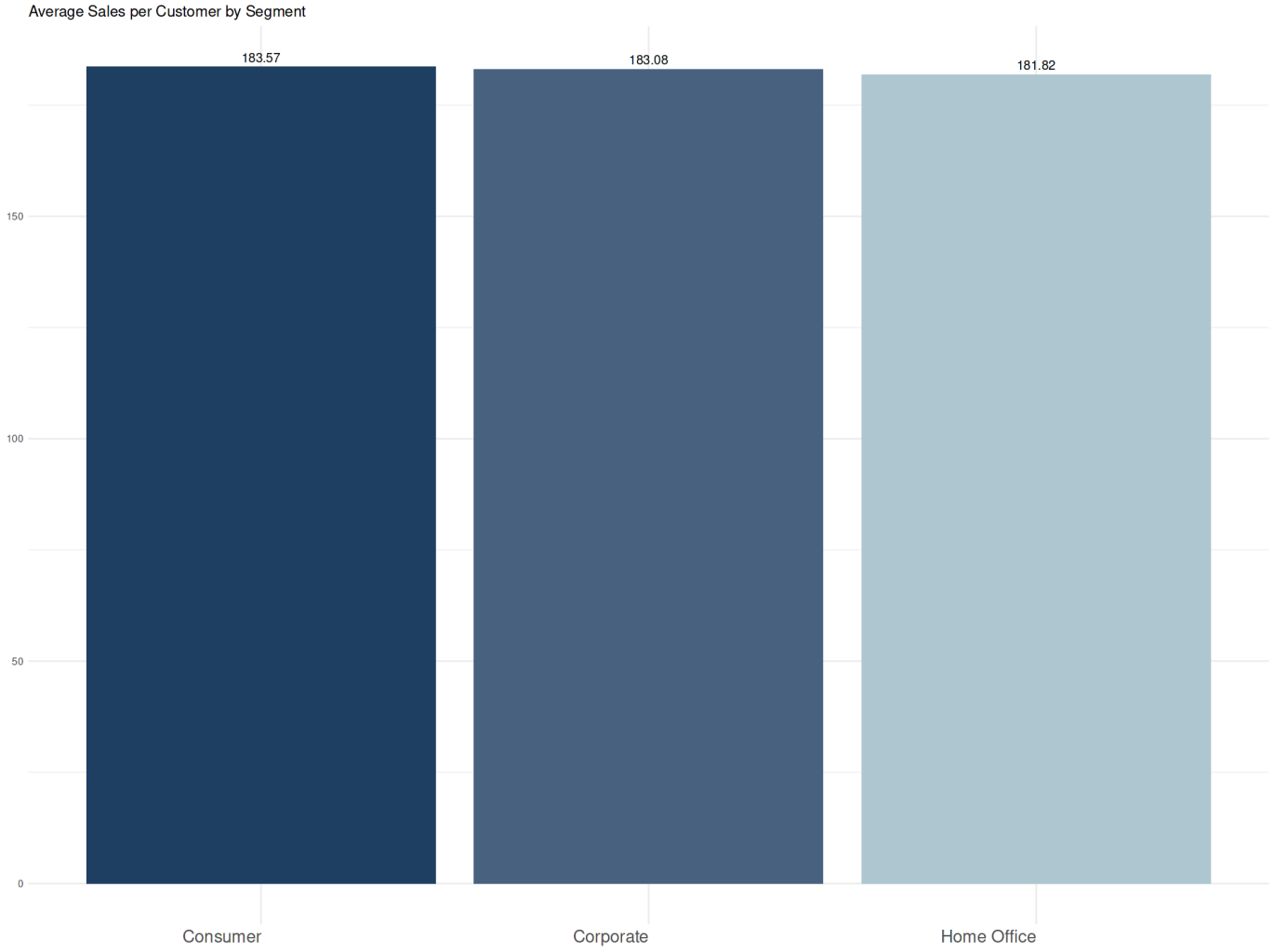
In [35]:
```r
# Create the customer_profit dataframe
customer_profit <- df %>%
  group_by(Customer.Segment) %>%
  summarise(total_profit = sum(Order.Profit.Per.Order, na.rm = TRUE))

# Plot with a heatmap effect using a gradient
ggplot(customer_profit, aes(x = Customer.Segment, y = total_profit, fill = total_profit)
  geom_bar(stat = "identity") +
  geom_text(aes(label = paste("$", round(total_profit, 2), sep='')), vjust = -0.5) +
  labs(title = "Total Profit by Customer Segment", y = "Total Profit", x = "Customer Seg
  scale_fill_gradient(low = "#AEC6CF", high = "#1E3E62") +  # Heatmap effect with gradie
  theme_minimal()
```



- Answer: the most customer seg contributes to profit is **Consumer**.

1. **Average sales per customer in each segment?**

In [36]:
```
## Summarizing average sales by customer segment
segment_sales <- df %>%
  group_by(Customer.Segment) %>%
  summarise(avg_sales = mean(Sales.per.customer, na.rm = TRUE))

# Plotting the data with a heatmap effect
ggplot(segment_sales, aes(x = Customer.Segment, y = avg_sales, fill = avg_sales)) +
  geom_bar(stat = "identity") +
  geom_text(aes(label = round(avg_sales, 2)), vjust = -0.5) +
  labs(title = "Average Sales per Customer by Segment", y = "", x = "") +
  scale_fill_gradient(low = "#AEC6CF", high = "#1E3E62") +  # Heatmap effect with gradie
  theme_minimal() +
  theme(axis.text.x = element_text(hjust = 1, size = 15)) +
  theme(legend.position = "none")
```



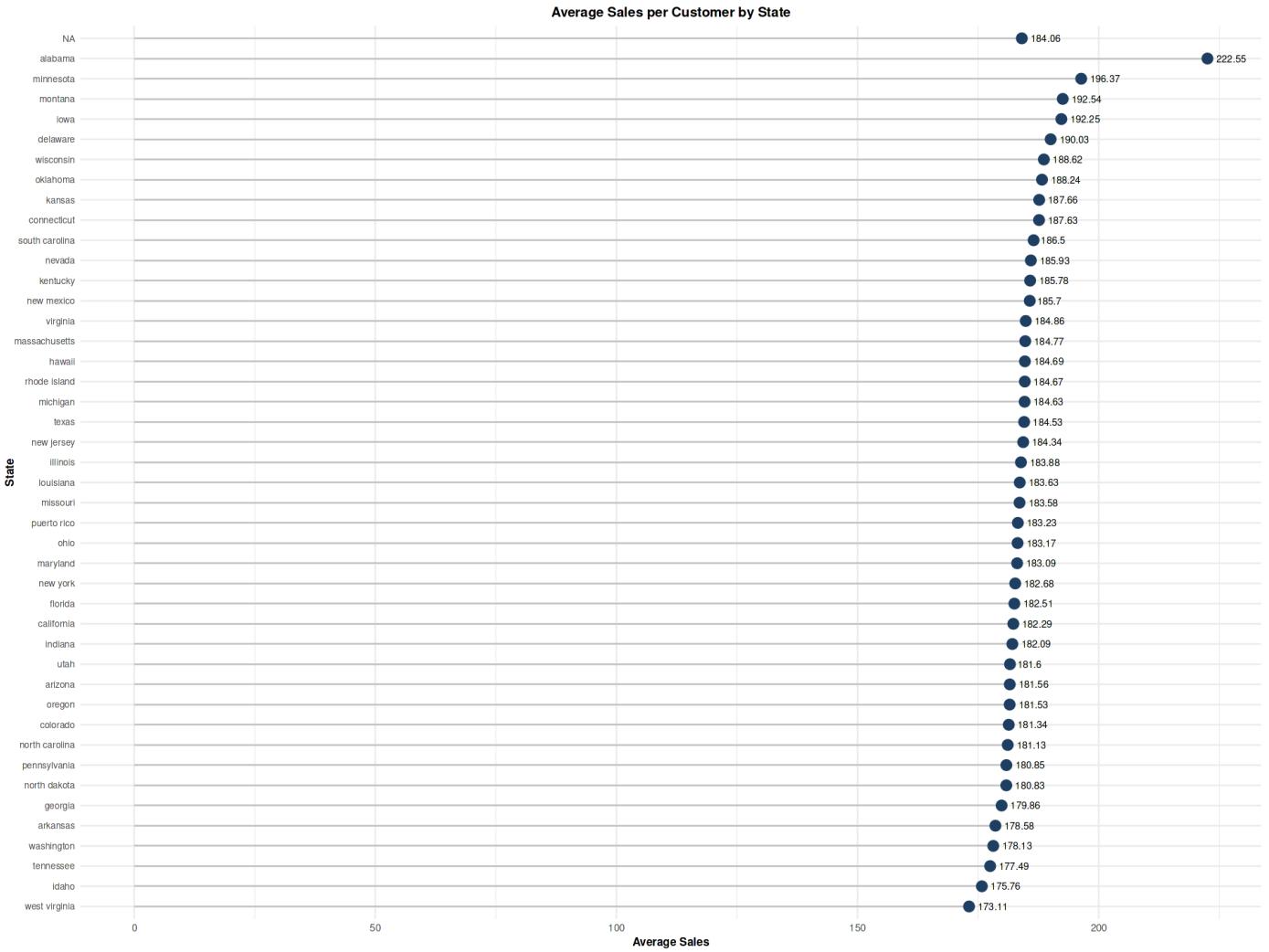
Geographic Analysis of Customers

Customers' geographical distribution can be analyzed by their location attributes like **city**, **state**, or **country**.

1. **Which states have the highest sales per customer?**

In [37]:
```r
# Step 1: Create a conversion table for state abbreviations and full names
state_abbreviations <- data.frame(
  state = tolower(c(state.name, "puerto rico")),  # Add "Puerto Rico" to U.S. state name
  abb = c(state.abb, "PR")  # Add "PR" abbreviation for Puerto Rico
)

# Step 2: Summarizing average sales per customer by state
# Merge the conversion table with your data to get full state names
state_sales <- df %>%
  left_join(state_abbreviations, by = c("Customer.State" = "abb")) %>%  # Convert abbrev
  group_by(state) %>%  # Group by the full state name now
  summarise(avg_sales = mean(Sales.per.customer, na.rm = TRUE)) %>%
  arrange(desc(avg_sales))  # Order states by average sales

# Step 3: Create a lollipop chart
ggplot(state_sales, aes(x = reorder(state, avg_sales), y = avg_sales)) +
  geom_segment(aes(x = reorder(state, avg_sales), xend = reorder(state, avg_sales),
                   y = 0, yend = avg_sales), color = "gray") +  # Lollipop stick
  geom_point(color = FILL_COLOR, size = 4) +  # Lollipop circle
  geom_text(aes(label = round(avg_sales, 2)), hjust = -0.3, size = 3) +  # Add text labe
  labs(title = "Average Sales per Customer by State", y = "Average Sales", x = "State")
  coord_flip() +  # Flip the chart for better readability
```

```
  theme_minimal() +
  theme(
    axis.text.y = element_text(size = 8),  # Adjust y-axis text size for readability
    axis.title.x = element_text(size = 10, face = "bold"),  # Bold x-axis title
    axis.title.y = element_text(size = 10, face = "bold"),  # Bold y-axis title
    plot.title = element_text(size = 12, face = "bold", hjust = 0.5)  # Title centered a
  )
```



- Answer: **Alabama** state is the highest sales per customer.

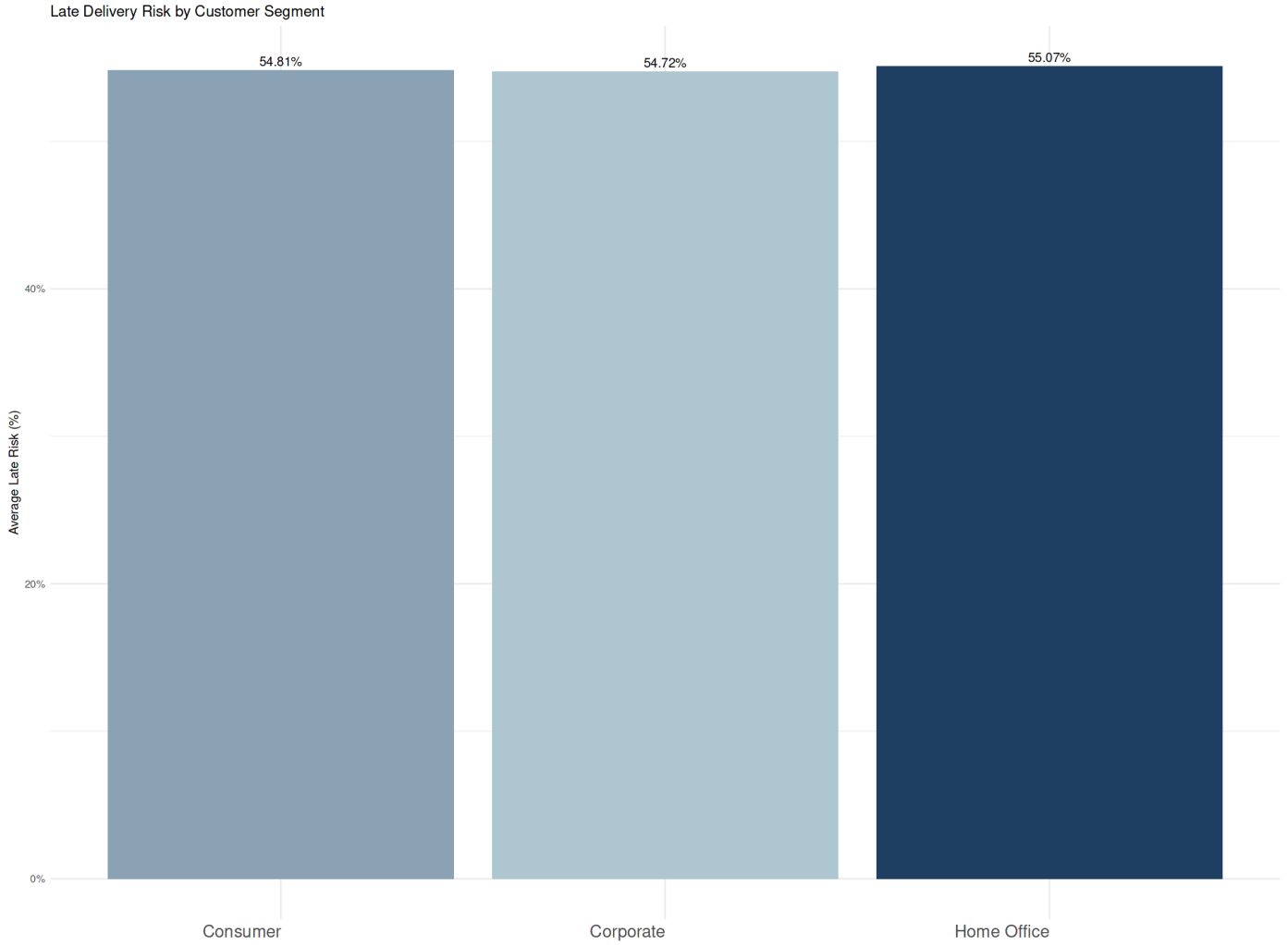
Customer Retention and Delivery Performance

Analyze how late delivery risk impacts customer segments or geographic areas. This is essential for improving service quality and customer satisfaction..

1. **Which customer segments have the highest late delivery risk?**

In [38]:
```
# Calculate average late delivery risk by customer segment
segment_late_risk <- df %>%
  group_by(Customer.Segment) %>%
  summarise(late_risk = mean(Late_delivery_risk, na.rm = TRUE)) %>%
  ungroup()

# Plotting the average late delivery risk with a heatmap effect
ggplot(segment_late_risk, aes(x = Customer.Segment, y = late_risk, fill = late_risk)) +
  geom_bar(stat = "identity") +
  geom_text(aes(label = scales::percent(late_risk, accuracy = 0.01)), vjust = -0.5) +  #
```

```
  labs(title = "Late Delivery Risk by Customer Segment",
       y = "Average Late Risk (%)",  # Updated y-axis label
       x = "") +
  scale_y_continuous(labels = scales::percent) +  # Formatting y-axis as percentage
  scale_fill_gradient(low = "#AEC6CF", high = "#1E3E62") +  # Heatmap effect with gradie
  theme_minimal() +
  theme(axis.text.x = element_text(hjust = 1, size = 15)) +
  theme(
    legend.position = "none"
  )
```



- Answer: **home office** have the highest late delivery risk.

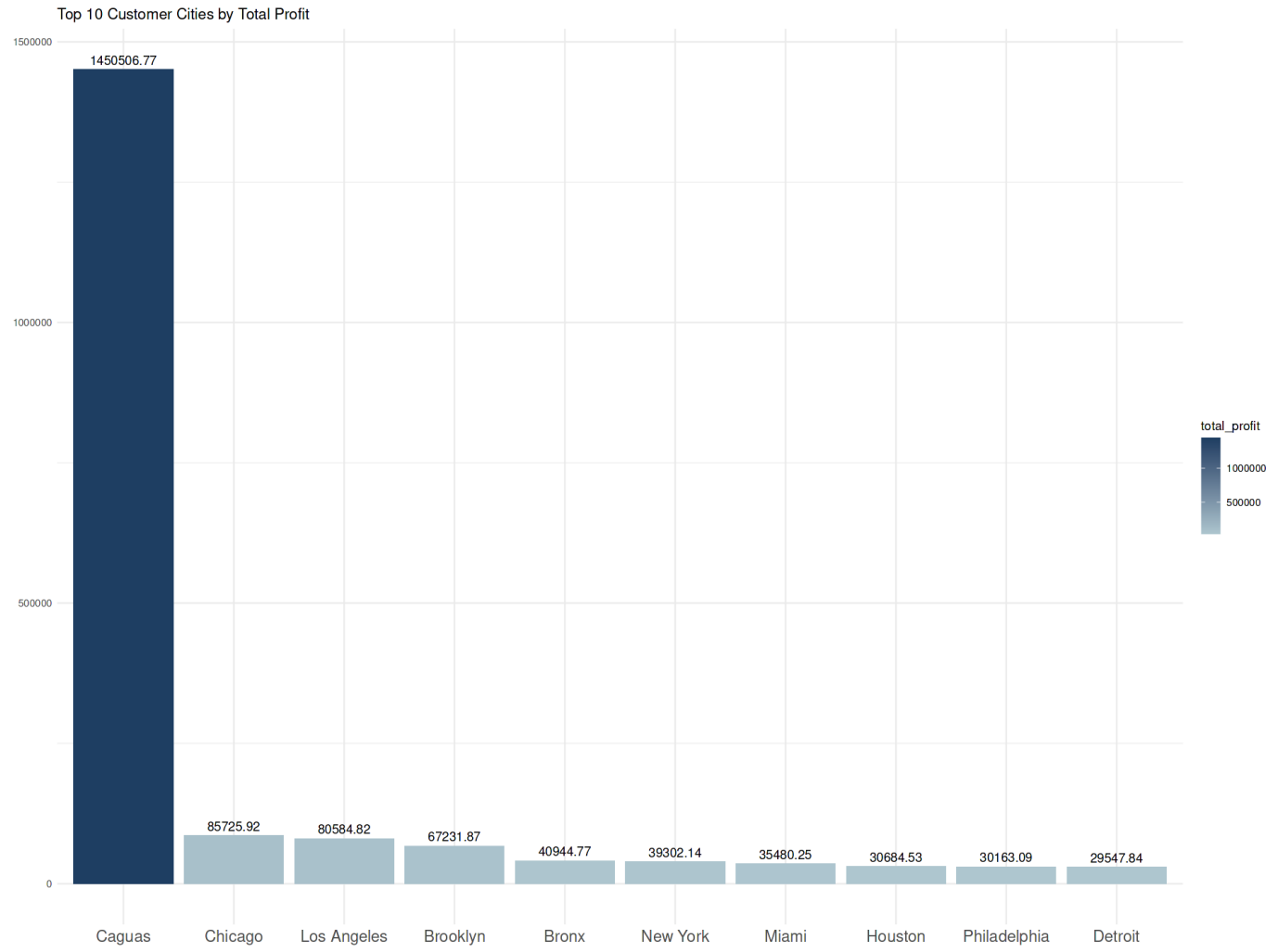
Customer Profitability

Understanding how much profit each customer generates is essential to focus on high-value customers.

1. **Find Top 10 customer cities by total profit?**

In [39]:
```
# Create a palette based on the base color #1E3E62
base_color <- "#1E3E62"
palette <- colorRampPalette(c(base_color, "#AEC6CF", "#D9EAD3", "#FFE599", "#B6D7A8"))(1

# Create the top_customers dataframe
top_customers <- df %>%
  group_by(Customer.City) %>%
  summarise(total_profit = sum(Order.Profit.Per.Order, na.rm = TRUE)) %>%
```

```
  arrange(desc(total_profit)) %>%
  head(10)

# Plot with a heatmap effect using a gradient
ggplot(top_customers, aes(x = reorder(Customer.City, -total_profit), y = total_profit, f
  geom_bar(stat = "identity") +
  geom_text(aes(label = round(total_profit, 2)), vjust = -0.5) +
  labs(title = "Top 10 Customer Cities by Total Profit", y = "", x = "") +
  scale_fill_gradient(low = "#AEC6CF", high = base_color) +  # Heatmap effect with gradi
  theme_minimal() +
  theme(axis.text.x = element_text(hjust = 0.5, size = 14))
```



Product Analysis

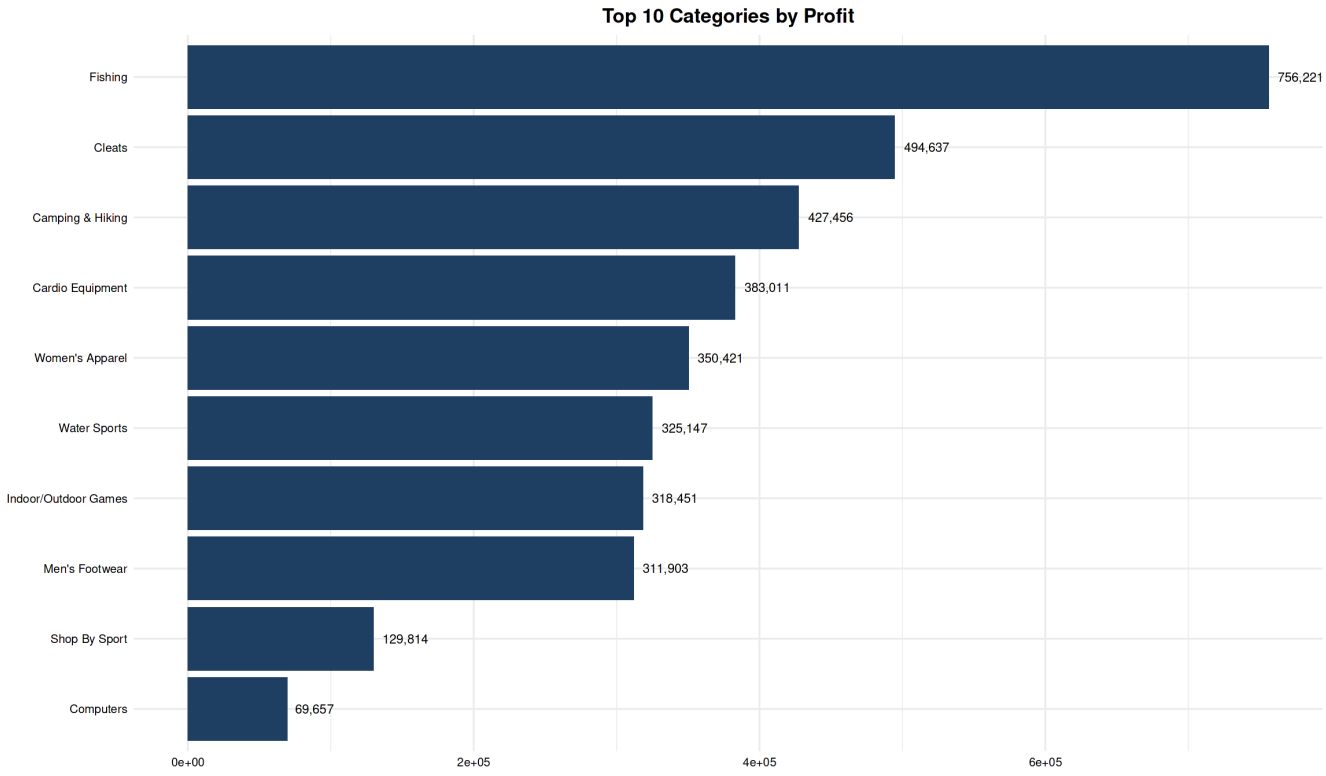
Product analysis helps businesses understand the performance of their products and identify opportunities for improvement or expansion.

1. **Find Top 10 Categories by Profit.**

In [40]:

```
options(repr.plot.width = 20, repr.plot.height = 12)

# Summarize profit by category and limit to top 10
category_profit <- df %>%
  group_by(Category.Name) %>%
  summarize(Total_Profit = sum(Order.Profit.Per.Order, na.rm = TRUE)) %>%
  arrange(desc(Total_Profit)) %>%
  head(10)  # Limit to top 10
```

```
# Plot top 10 categories by profit with numbers formatted using scales
ggplot(category_profit, aes(x = reorder(Category.Name, Total_Profit), y = Total_Profit))
  geom_bar(stat = "identity", fill = FILL_COLOR) +  # Custom color
  geom_text(aes(label = scales::comma(Total_Profit)), hjust = -0.2, size = 4.5, color =
  coord_flip() +
  theme_minimal(base_size = 15) +  # Modern theme with larger text
  labs(title = "Top 10 Categories by Profit",
       x = "",
       y = "") +
  theme(plot.title = element_text(hjust = 0.5, face = "bold", size = 20),
        axis.title.x = element_text(face = "bold"),
        axis.title.y = element_text(face = "bold"),
        axis.text = element_text(color = "black"),
        plot.margin = unit(c(1, 1, 1, 1), "cm"))
```

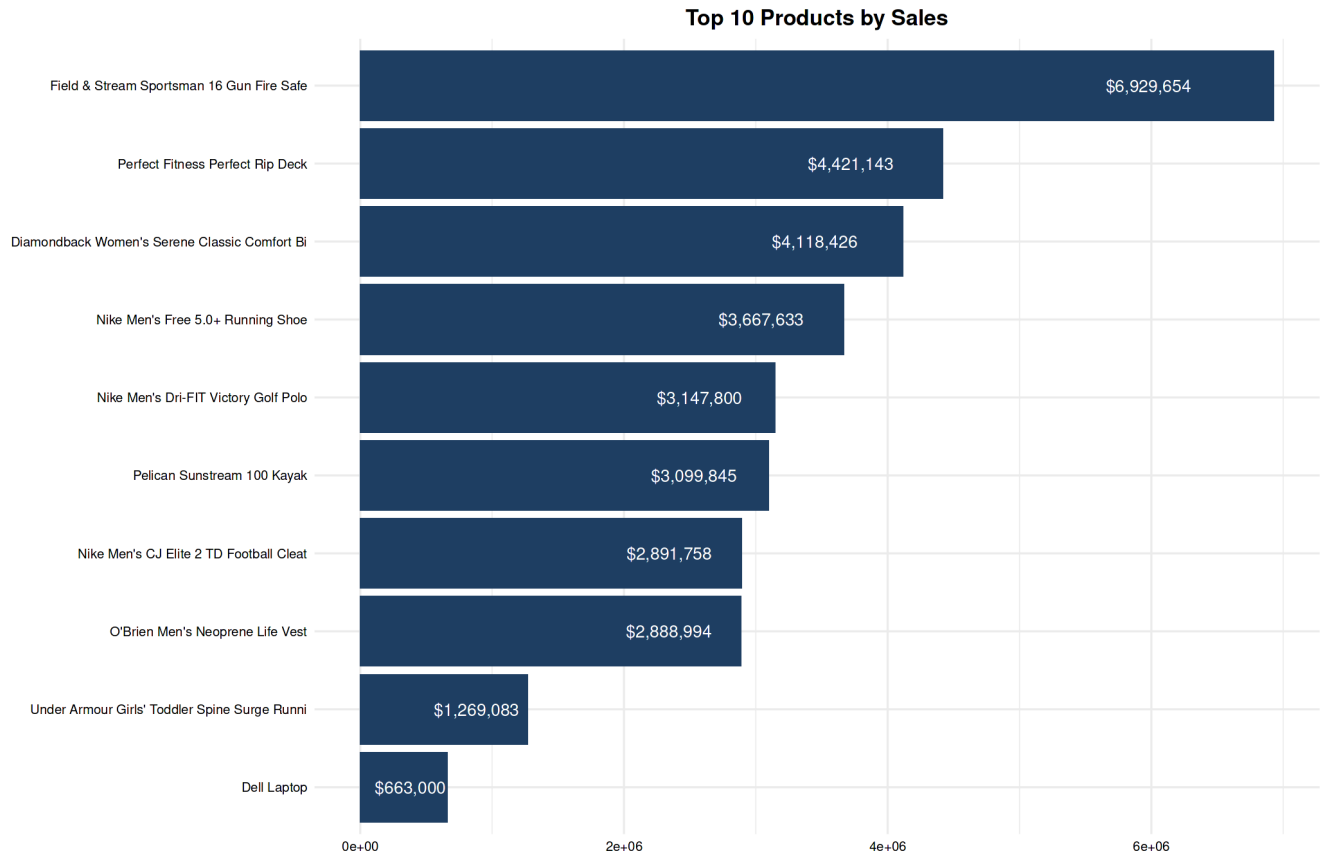


1. **Find Top 10 Products by Sales.**

In [41]:

```
options(repr.plot.width = 18, repr.plot.height = 12)

# Summarize total sales by product and limit to top 10
product_sales <- df %>%
  group_by(Product.Name) %>%
  summarize(Total_Sales = sum(Sales, na.rm = TRUE)) %>%
  arrange(desc(Total_Sales)) %>%
  head(10)  # Limit to top 10

# Plot top 10 products by sales with numbers inside bars
ggplot(product_sales, aes(x = reorder(Product.Name, Total_Sales), y = Total_Sales)) +
  geom_bar(stat = "identity", fill = FILL_COLOR) +  # Custom color
  geom_text(aes(label = scales::dollar(Total_Sales, prefix = "$", accuracy = 1)), hjust
  coord_flip() +
  theme_minimal(base_size = 15) +  # Modern theme
  labs(title = "Top 10 Products by Sales",
       x = "",
       y = "") +
  theme(plot.title = element_text(hjust = 0.5, face = "bold", size = 20),
        axis.title.x = element_text(face = "bold"),
```

```
        axis.title.y = element_text(face = "bold"),
        axis.text = element_text(color = "black"),
        plot.margin = unit(c(1, 1, 1, 1), "cm"))
```



1. **Find Total Profit by Customer City.**

In [42]:

```
library(leaflet)
library(htmltools)

# Step 1: Prepare the customer location data
location_data <- df %>%
  select(Customer.City, Customer.Country, Latitude, Longitude, Order.Profit.Per.Order) %
  group_by(Customer.City, Customer.Country, Latitude, Longitude) %>%
  summarize(Total_Profit = sum(Order.Profit.Per.Order, na.rm = TRUE)) %>%
  ungroup()

# Step 2: Create a color palette based on profit bins
mybins <- quantile(location_data$Total_Profit, probs = seq(0, 1, by = 0.2), na.rm = TRUE
mypalette <- colorBin(palette = "YlOrBr", domain = location_data$Total_Profit, na.color

# Step 3: Prepare the text for tooltips
mytext <- paste0(
  "<strong>City: </strong>", location_data$Customer.City, "<br/>",
  "<strong>Country: </strong>", location_data$Customer.Country, "<br/>",
  "<strong>Total Profit: </strong>$", round(location_data$Total_Profit, 2)
) %>% lapply(htmltools::HTML)

# Step 4: Create the leaflet map
interactive_map <- leaflet(location_data) %>%
  addTiles() %>%
  setView(lat = mean(location_data$Latitude, na.rm = TRUE),
          lng = mean(location_data$Longitude, na.rm = TRUE),
          zoom = 2) %>%
  addProviderTiles("Esri.WorldImagery") %>%
```

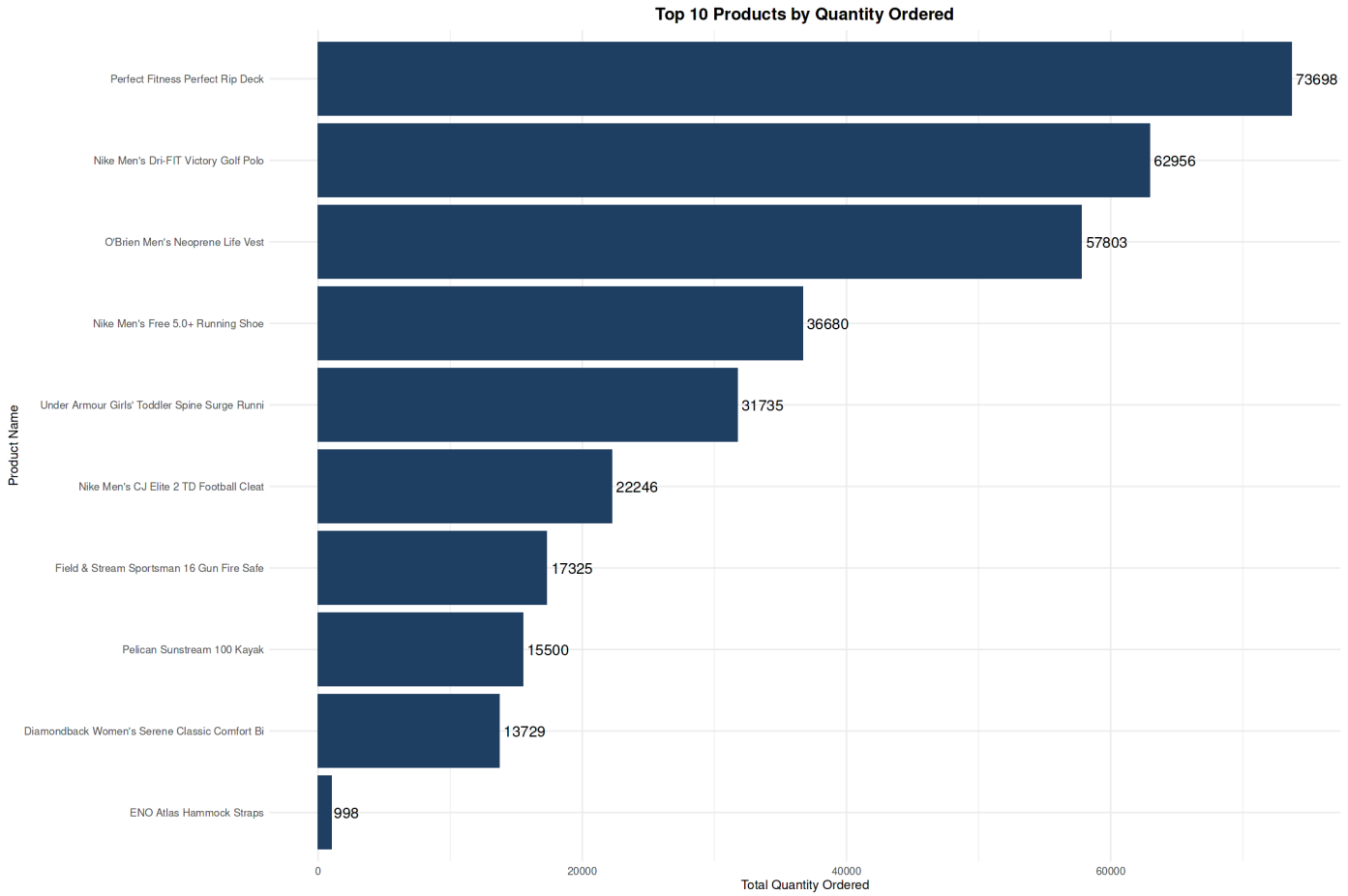
```
  addCircleMarkers(~Longitude, ~Latitude,
    fillColor = ~mypalette(Total_Profit), fillOpacity = 0.7, color = "white", radius = 8
    label = mytext,
    labelOptions = labelOptions(
      style = list("font-weight" = "normal", padding = "3px 8px"),
      textsize = "13px", direction = "auto"
    )
  ) %>%
  addLegend(
    pal = mypalette, values = ~Total_Profit,
    opacity = 0.9, title = "Total Profit",
    position = "bottomright"
  )

# Step 5: Display the interactive map
interactive_map
```

```
`summarise()` has grouped output by 'Customer.City', 'Customer.Country',
'Latitude'. You can override using the `.groups` argument.
```

1. **Find Top 10 Products by Quantity Ordered.**

In [43]:
```
# Group by Product Name and calculate total quantity
top_products <- df %>%
  group_by(Product.Name) %>%
  summarise(Total.Quantity = sum(Order.Item.Quantity, na.rm = TRUE)) %>%  # Handle NA va
  arrange(desc(Total.Quantity)) %>%
  slice_head(n = 10)  # Use slice_head() instead of head() for consistency with dplyr sy

# Create a bar plot using ggplot2
ggplot(top_products, aes(x = reorder(Product.Name, Total.Quantity), y = Total.Quantity))
  geom_bar(stat = "identity", fill = FILL_COLOR) +  # Bar color
  geom_text(aes(label = Total.Quantity), hjust = -0.1, size = 5, color = "black") +  # A
  coord_flip() +  # Flip coordinates for better readability
  labs(
    title = "Top 10 Products by Quantity Ordered",
    x = "Product Name",
    y = "Total Quantity Ordered"
  ) +
```

```
  theme_minimal() +
  theme(
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"),  # Center-align ti
    axis.text.y = element_text(size = 10),  # Adjust y-axis text size
    axis.text.x = element_text(size = 10),  # Adjust x-axis text size
    axis.title = element_text(size = 12)    # Adjust axis title size
  )
```

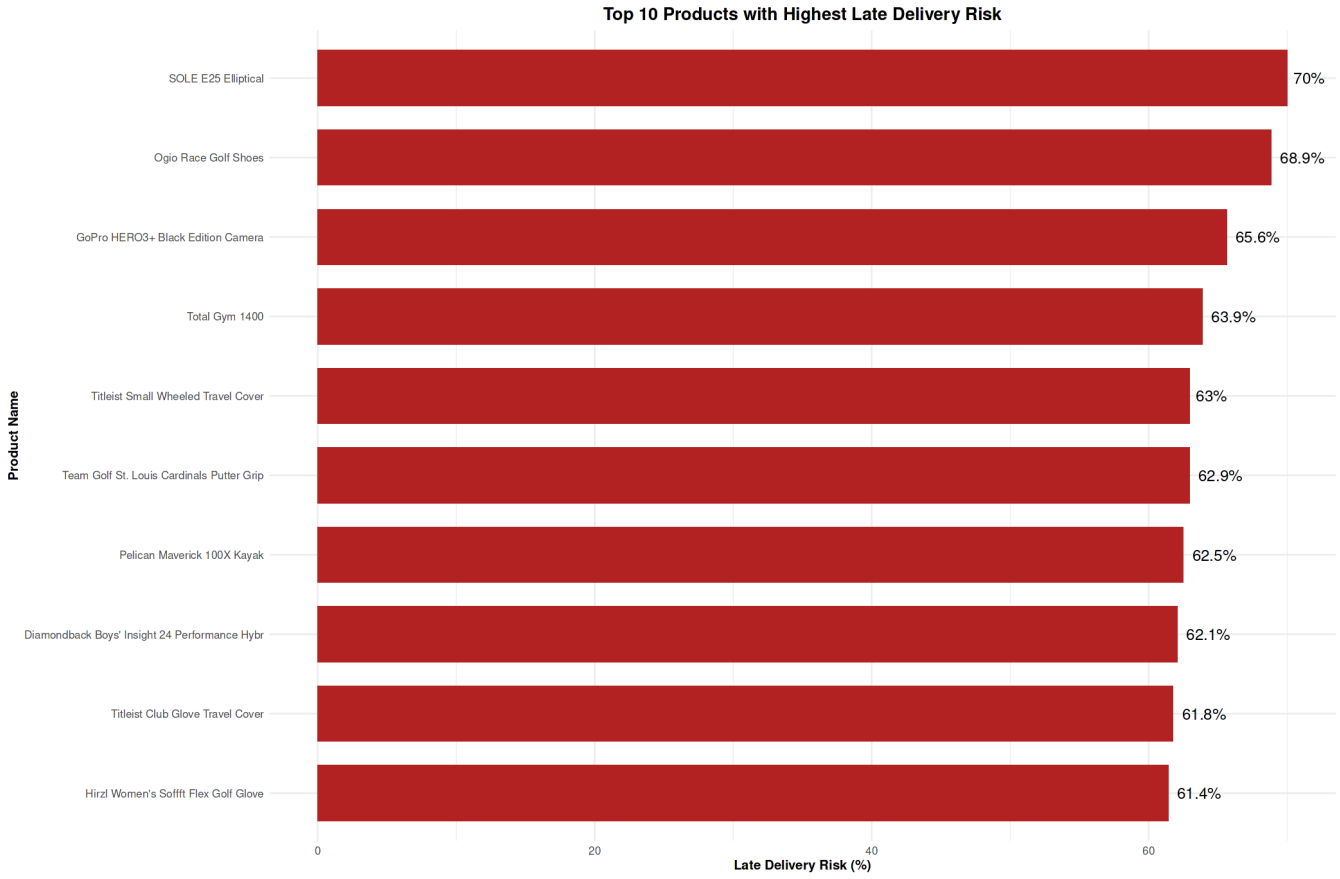


1. **Find Top 10 Products with Highest Late Delivery Risk.**

In [44]:

```
# Define fill color for the bar plot
FILL_COLOR <- "firebrick"

# Group by Product Name and calculate late delivery statistics
top_risk_products <- df %>%
  group_by(Product.Name) %>%
  summarise(
    Total.Orders = n(),
    Late.Orders = sum(Late_delivery_risk, na.rm = TRUE)  # Handle potential NA values in
  ) %>%
  mutate(Percent.Late.Risk = (Late.Orders / Total.Orders) * 100) %>%
  arrange(desc(Percent.Late.Risk)) %>%
  slice_head(n = 10)  # Select top 10 products

# Visualize the top products with late delivery risk percentages
ggplot(top_risk_products, aes(x = reorder(Product.Name, Percent.Late.Risk), y = Percent.
  geom_bar(stat = "identity", fill = FILL_COLOR, width = 0.7) +  # Add width for better
  geom_text(
    aes(label = paste0(round(Percent.Late.Risk, 1), "%")),
    hjust = -0.2, size = 5, color = "black"
  ) +  # Show percentage labels outside the bars
  coord_flip() +  # Flip coordinates for better readability
  labs(
    title = "Top 10 Products with Highest Late Delivery Risk",
```

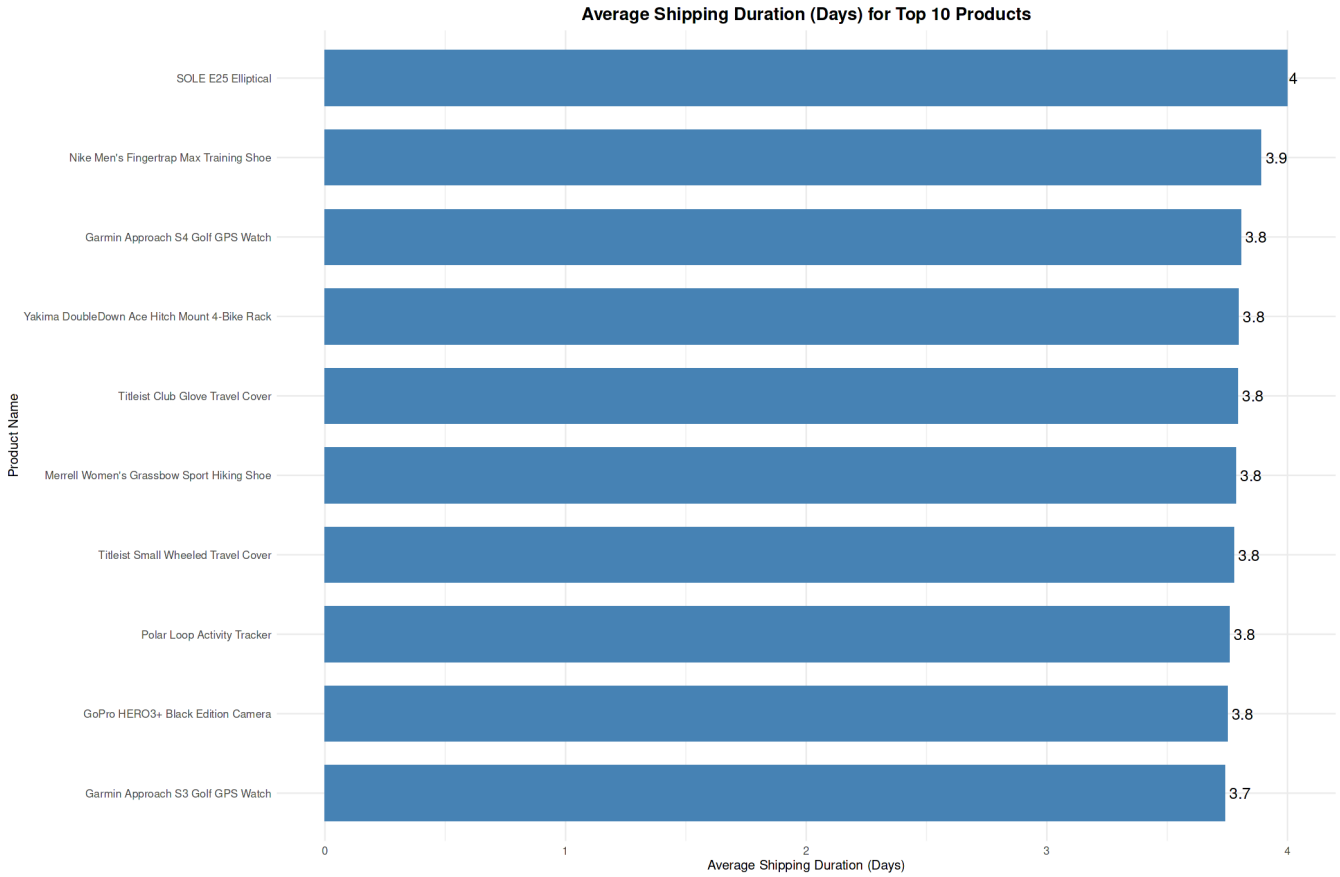
```
    x = "Product Name",
    y = "Late Delivery Risk (%)"
  ) +
  theme_minimal() +
  theme(
    plot.title = element_text(hjust = 0.5, face = "bold", size = 16),
    axis.title.x = element_text(size = 12, face = "bold"),
    axis.title.y = element_text(size = 12, face = "bold"),
    axis.text = element_text(size = 10),
    plot.margin = unit(c(1, 1, 1, 1), "cm")  # Ensure enough margin for labels
  )
```



1. **Find the most shipping duration of products.**

In [45]:
```
# Define the color for the bars
FILL_COLOR <- "steelblue"

# Filter data for valid shipping durations
filtered_df <- df %>%
  filter(shipping_duration >= 0)  # Exclude negative durations, if any

# Calculate the average shipping duration by product
top_shipping_duration <- filtered_df %>%
  group_by(Product.Name) %>%
  summarise(Avg.Shipping.Duration = mean(shipping_duration, na.rm = TRUE)) %>%  # Handle
  arrange(desc(Avg.Shipping.Duration)) %>%  # Sort by highest average shipping duration
  slice_head(n = 10)  # Select the top 10 products

# Visualize the average shipping duration for the top products
ggplot(top_shipping_duration, aes(x = reorder(Product.Name, Avg.Shipping.Duration), y =
  geom_bar(stat = "identity", fill = FILL_COLOR, width = 0.7) +  # Adjust bar width
  geom_text(
    aes(label = round(Avg.Shipping.Duration, 1)),
    hjust = -0.2, size = 5, color = "black"
```

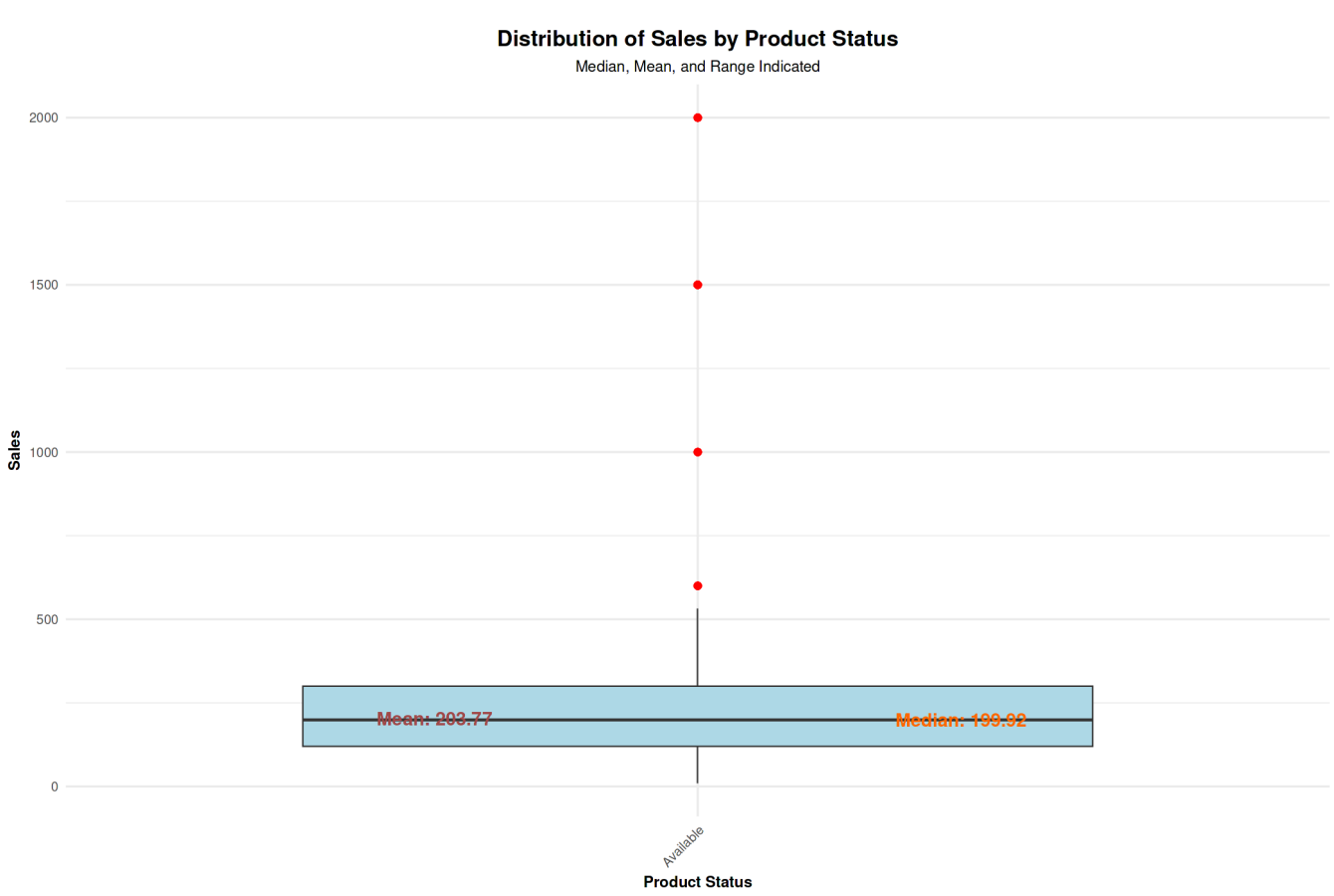
```
) +  # Add average shipping duration as labels
coord_flip() +  # Flip coordinates for better readability
labs(
  title = "Average Shipping Duration (Days) for Top 10 Products",
  x = "Product Name",
  y = "Average Shipping Duration (Days)"
) +
theme_minimal() +
theme(
  plot.title = element_text(hjust = 0.5, size = 16, face = "bold"),
  axis.title.x = element_text(size = 12),
  axis.title.y = element_text(size = 12),
  axis.text.y = element_text(size = 10),
  axis.text.x = element_text(size = 10),
  plot.margin = unit(c(1, 1, 1, 1), "cm")  # Ensure proper margins
)
```



1. **Find the Distribution of Sales by Product Status.**

In [46]:
```
# Boxplot of Sales by Product Status
ggplot(df, aes(x = Product.Status, y = Sales)) +
  geom_boxplot(fill = "lightblue", outlier.color = "red", outlier.shape = 16, outlier.si

  # Add median labels with improved alignment
  stat_summary(
    fun = median,
    geom = "text",
    aes(label = paste("Median:", round(..y.., 2))),
    position = position_nudge(x = 0.25),
    size = 6,
    color = "#FF6600",
    fontface = "bold"
  ) +
```

```r
# Add mean labels for each box
stat_summary(
  fun = mean,
  geom = "text",
  aes(label = paste("Mean:", round(..y.., 2))),
  position = position_nudge(x = -0.25),
  size = 6,
  color = "#A04747",
  fontface = "bold"
) +

# Add whisker labels (min and max values)
stat_summary(
  fun.min = min,
  fun.max = max,
  geom = "text",
  aes(label = round(..y.., 2)),
  position = position_nudge(x = 0.35),
  size = 5,
  color = "blue",
  fontface = "italic"
) +

# Titles and labels
labs(
  title = "Distribution of Sales by Product Status",
  subtitle = "Median, Mean, and Range Indicated",
  x = "Product Status",
  y = "Sales"
) +

# Enhanced theme for better visualization
theme_minimal(base_size = 16) +
theme(
  plot.title = element_text(face = "bold", size = 20, hjust = 0.5),
  plot.subtitle = element_text(size = 14, hjust = 0.5),
  axis.title.x = element_text(face = "bold", size = 14),
  axis.title.y = element_text(face = "bold", size = 14),
  axis.text.x = element_text(size = 12, angle = 45, hjust = 1),
  axis.text.y = element_text(size = 12),
  plot.margin = unit(c(1, 1, 1, 1), "cm")
)
```



Order Regions Analysis

we can explore various questions related to order regions (**Order.Region**), **profit**, **sales**, and **delivery risk**.

1. **Find Sales and Profit by Region.**

In [47]:
```
region_summary <- df %>%
  group_by(Order.Region) %>%
  summarise(
    Total_Sales = sum(Sales, na.rm = TRUE),
    Avg_Profit_Per_Order = mean(Order.Profit.Per.Order, na.rm = TRUE),
    Total_Late_Delivery_Risk = sum(Late_delivery_risk, na.rm = TRUE)
  )

# View the summary table
region_summary
```

A tibble: 23 × 4

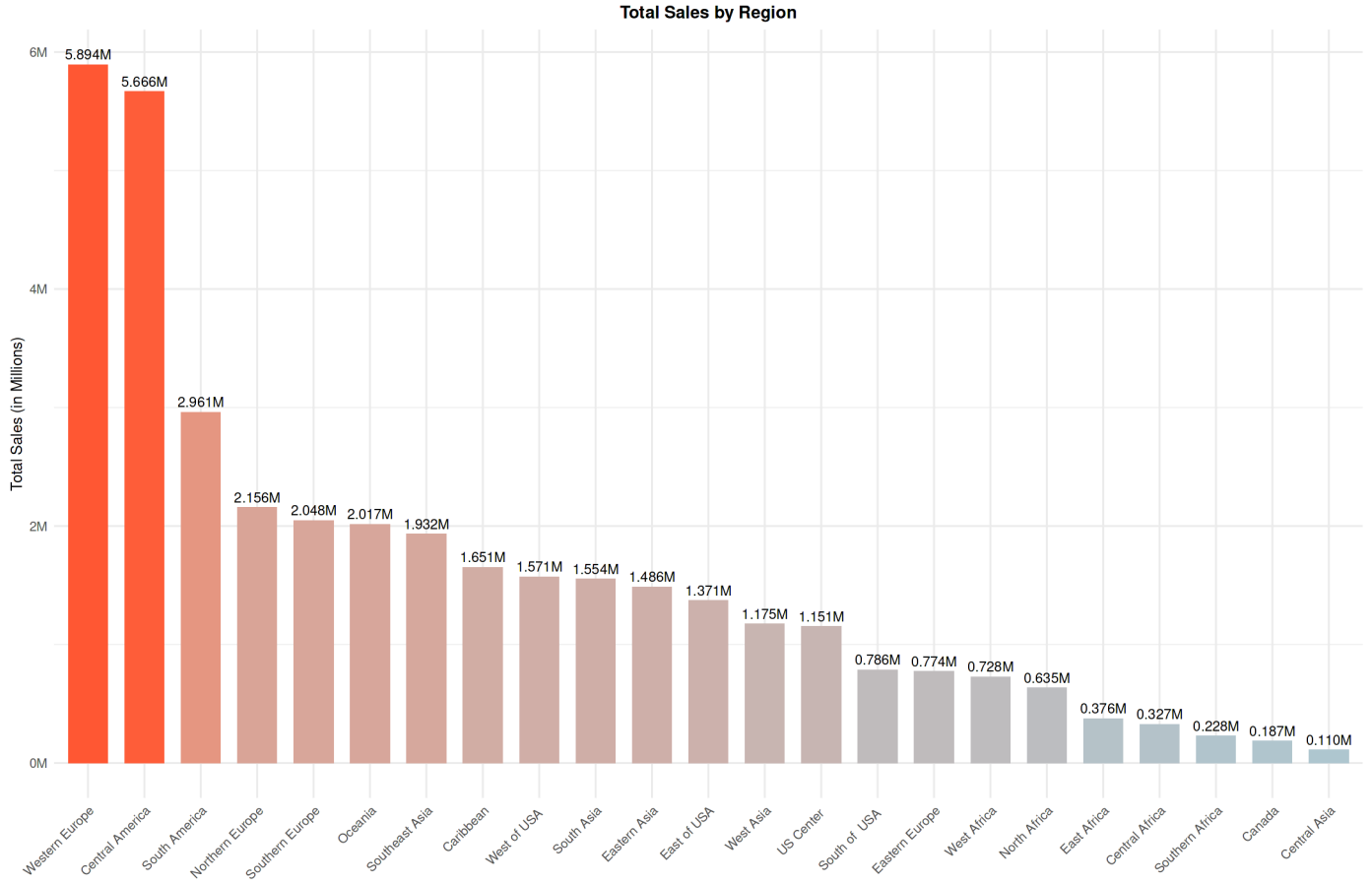
Order.Region	Total_Sales	Avg_Profit_Per_Order	Total_Late_Delivery_Risk
<chr>	<dbl>	<dbl>	<int>
Canada	186861.0	24.92253	468
Caribbean	1651019.3	20.65709	4415
Central Africa	327263.0	19.94470	972
Central America	5665712.1	21.74735	15518
Central Asia	109839.9	23.59002	306
East Africa	376234.9	23.30871	1036

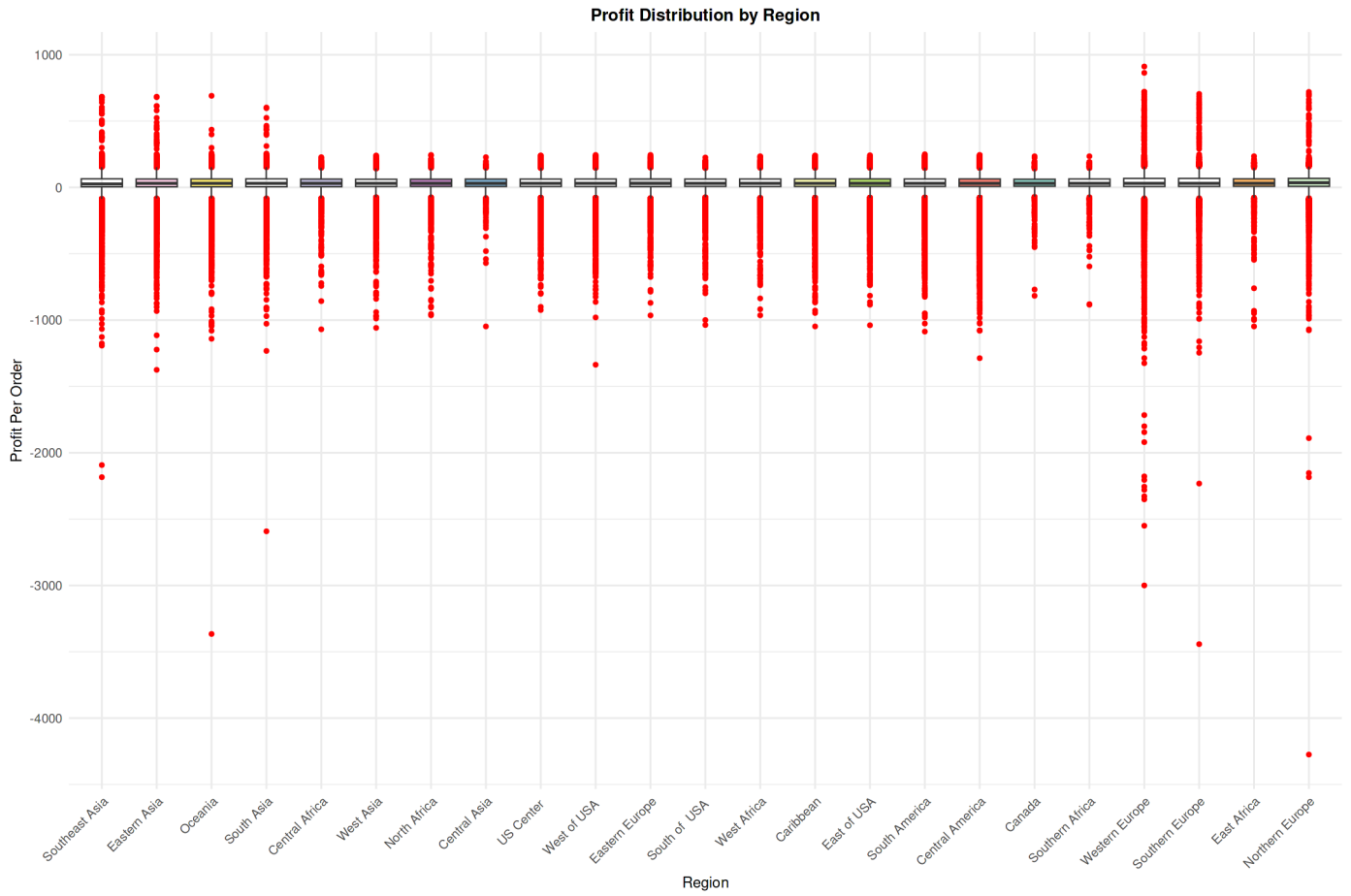
East of USA	1371112.0	22.59773	3849
Eastern Asia	1486401.3	20.24286	3955
Eastern Europe	774266.6	20.33598	2182
North Africa	634752.2	19.98758	1762
Northern Europe	2155830.6	23.84095	5292
Oceania	2016654.2	19.85396	5482
South America	2960881.4	22.44087	8111
South Asia	1553680.9	21.43370	4350
South of USA	785783.9	21.78365	2256
Southeast Asia	1932495.6	22.15566	5297
Southern Africa	228251.6	26.64309	617
Southern Europe	2047918.8	24.47558	5129
US Center	1151355.8	22.26843	3252
West Africa	727951.2	21.65321	1953
West Asia	1174671.8	19.77291	3322
West of USA	1571416.0	20.63564	4313
Western Europe	5894380.8	23.07153	15140

In [48]:

```
# Bar Plot for Total Sales by Region
ggplot(region_summary, aes(x = reorder(Order.Region, -Total_Sales), y = Total_Sales, fil
  geom_bar(stat = "identity", width = 0.7) +
  geom_text(aes(label = label_number(scale = 1e-6, suffix = "M")(Total_Sales)),
            vjust = -0.5, size = 4.5, color = "black") +
  scale_fill_gradient(low = "#AEC6CF", high = "#FF5733") +  # Gradient color for sales
  scale_y_continuous(labels = label_number(scale = 1e-6, suffix = "M")) +
  labs(
    title = "Total Sales by Region",
    x = "",
    y = "Total Sales (in Millions)"
  ) +
  theme_minimal(base_size = 14) +
  theme(
    plot.title = element_text(hjust = 0.5, face = "bold", size = 16),
    axis.text.x = element_text(angle = 45, hjust = 1, size = 12),
    axis.text.y = element_text(size = 12),
    legend.position = "none"
  )

# Boxplot for Profit Distribution by Region
ggplot(df, aes(x = reorder(Order.Region, Order.Profit.Per.Order, FUN = median),
               y = Order.Profit.Per.Order, fill = Order.Region)) +
  geom_boxplot(outlier.colour = "red", outlier.shape = 16, outlier.size = 2) +
  scale_fill_brewer(palette = "Set3") +  # Use a better color palette
  labs(
    title = "Profit Distribution by Region",
    x = "Region",
    y = "Profit Per Order"
  ) +
  theme_minimal(base_size = 14) +
  theme(
    plot.title = element_text(hjust = 0.5, face = "bold", size = 16),
    axis.text.x = element_text(angle = 45, hjust = 1, size = 12),
```

```
    axis.text.y = element_text(size = 12),
    legend.position = "none"
  )
```





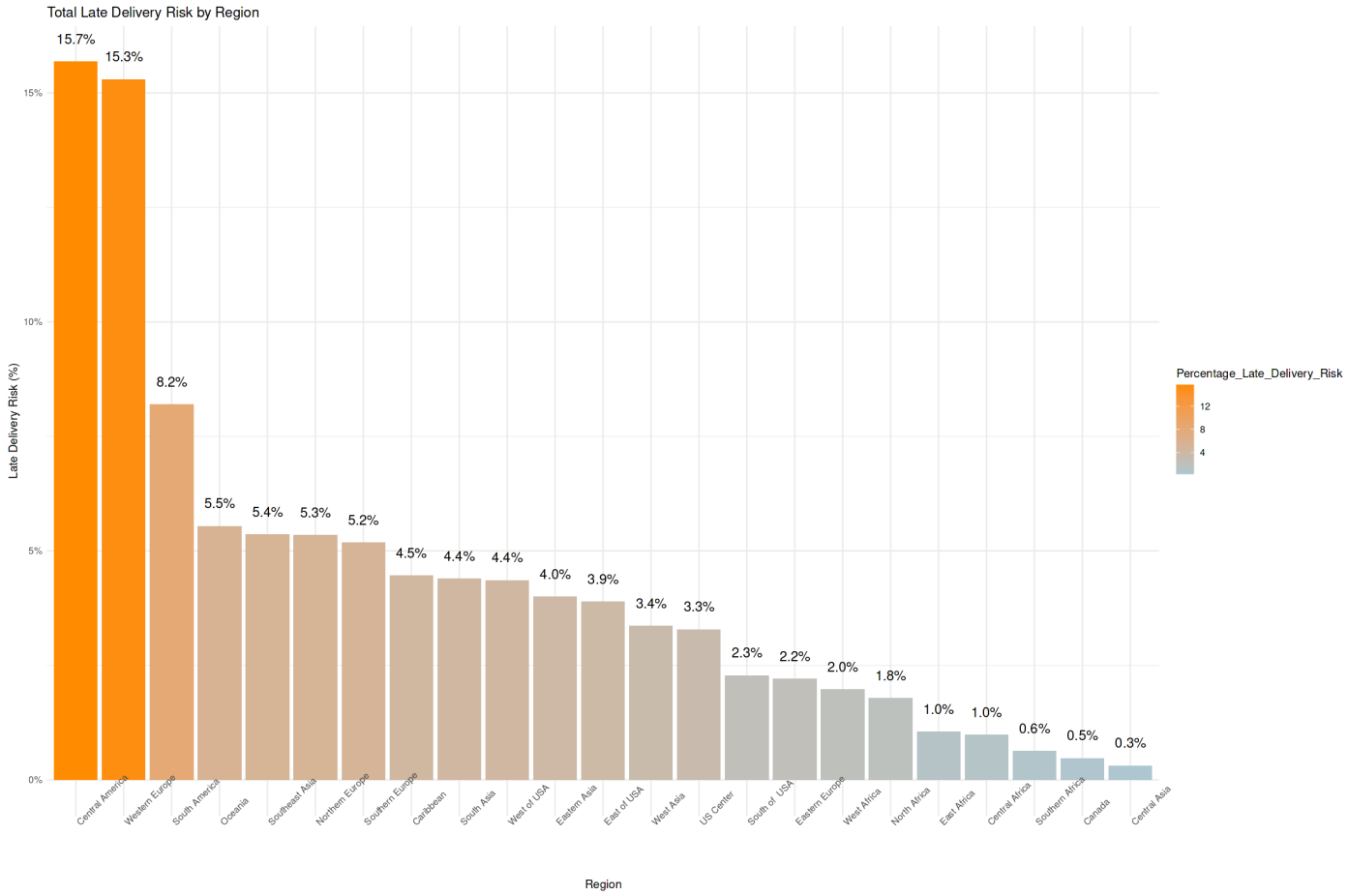
1. **Find the positive and negative profits by region.**

In [49]:
```r
# Grouping the data by region and calculating positive and negative profits
profit_summary <- df %>%
  group_by(Order.Region) %>%
  summarise(
    Positive_Profit = sum(Order.Profit.Per.Order[Order.Profit.Per.Order > 0], na.rm = TR
    Negative_Profit = sum(Order.Profit.Per.Order[Order.Profit.Per.Order < 0], na.rm = TR
  )

# Reshaping the data for plotting
profit_long <- profit_summary %>%
  pivot_longer(cols = c(Positive_Profit, Negative_Profit), names_to = "Profit_Type", val

# Creating the interactive bar plot
library(plotly)

fig <- plot_ly(profit_long, x = ~Order.Region, y = ~Amount, color = ~Profit_Type, type =
               text = ~Amount, textposition = 'auto') %>%
  layout(
    title = 'Positive and Negative Profits by Region',
    xaxis = list(title = 'Region', tickangle = -45),
    yaxis = list(title = 'Profit Amount'),
    barmode = 'stack',  # Stacked bars for clear comparison
    showlegend = TRUE
  )

# Display the interactive plot
fig
```

1. **Find the total late delivery risk by region.**

In [50]:
```r
# Summarize the total late delivery risk by region
region_summary <- df %>%
  group_by(Order.Region) %>%
  summarise(Total_Late_Delivery_Risk = sum(Late_delivery_risk, na.rm = TRUE))

# Calculate the total late delivery risk for all regions
total_risk <- sum(region_summary$Total_Late_Delivery_Risk)
```

```r
# Calculate percentage late delivery risk for each region
region_summary <- region_summary %>%
  mutate(Percentage_Late_Delivery_Risk = (Total_Late_Delivery_Risk / total_risk) * 100)

# Visualize the Late Delivery Risk by Region
ggplot(region_summary, aes(x = reorder(Order.Region, -Percentage_Late_Delivery_Risk),
                           y = Percentage_Late_Delivery_Risk,
                           fill = Percentage_Late_Delivery_Risk)) +
  geom_bar(stat = "identity") +
  geom_text(aes(label = label_percent(accuracy = 0.1)(Percentage_Late_Delivery_Risk / 10
            hjust = 0.5, vjust = -1.8, size = 4.5, color = "black") +  # Add percentage
  scale_fill_gradient(low = "#AEC6CF", high = "darkorange") +  # Color gradient for bett
  scale_y_continuous(labels = label_percent(scale = 1)) +  # Format the y-axis as percen
  theme_minimal() +
  labs(title = "Total Late Delivery Risk by Region",
       x = "Region",
       y = "Late Delivery Risk (%)") +
  theme(axis.text.x = element_text(angle = 45, hjust = 0))  # Rotate x-axis labels for b
```



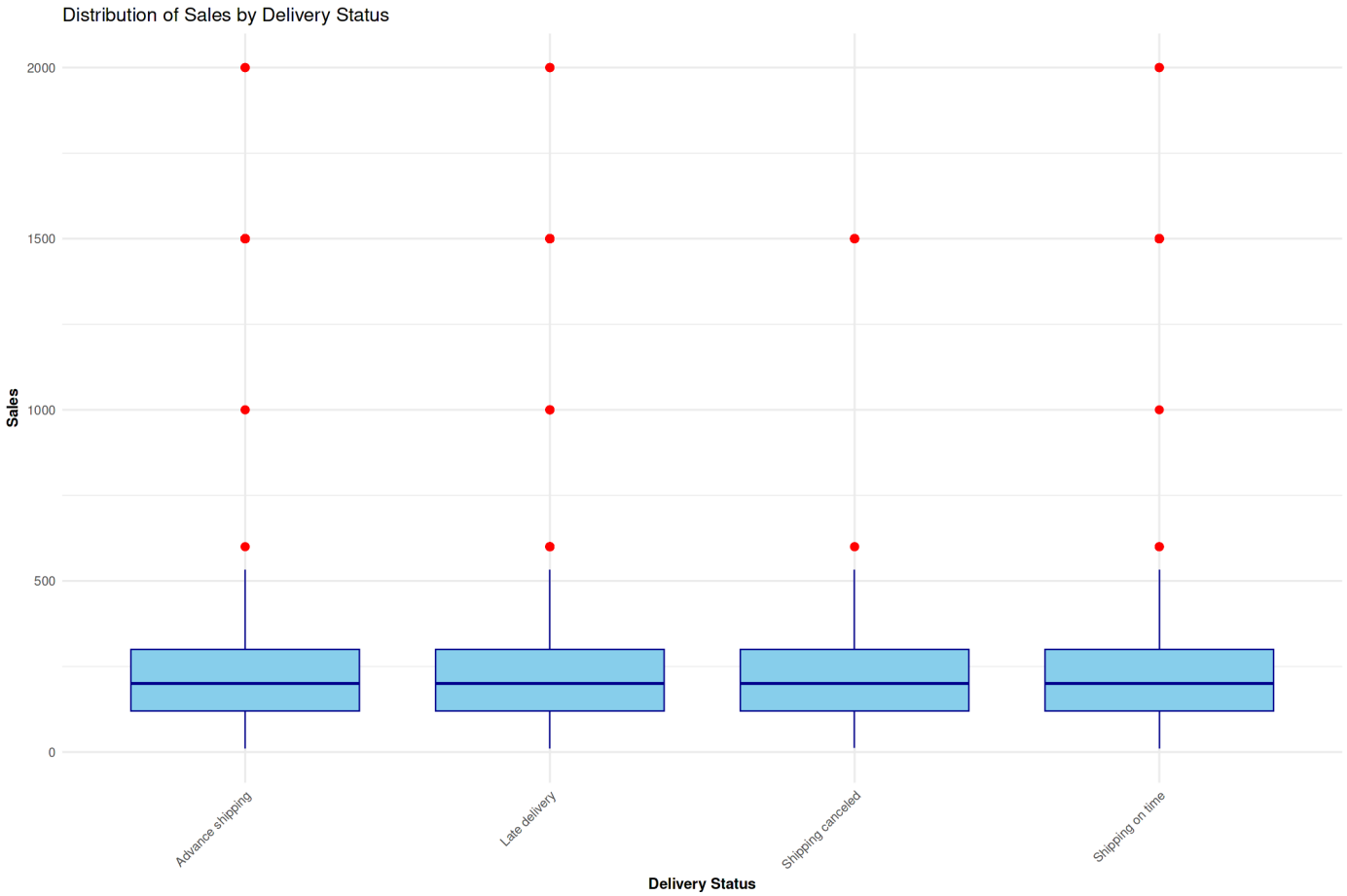
Additional Analysis

1. **Find the Distribution of Sales by Delivery Status.**

In [51]:

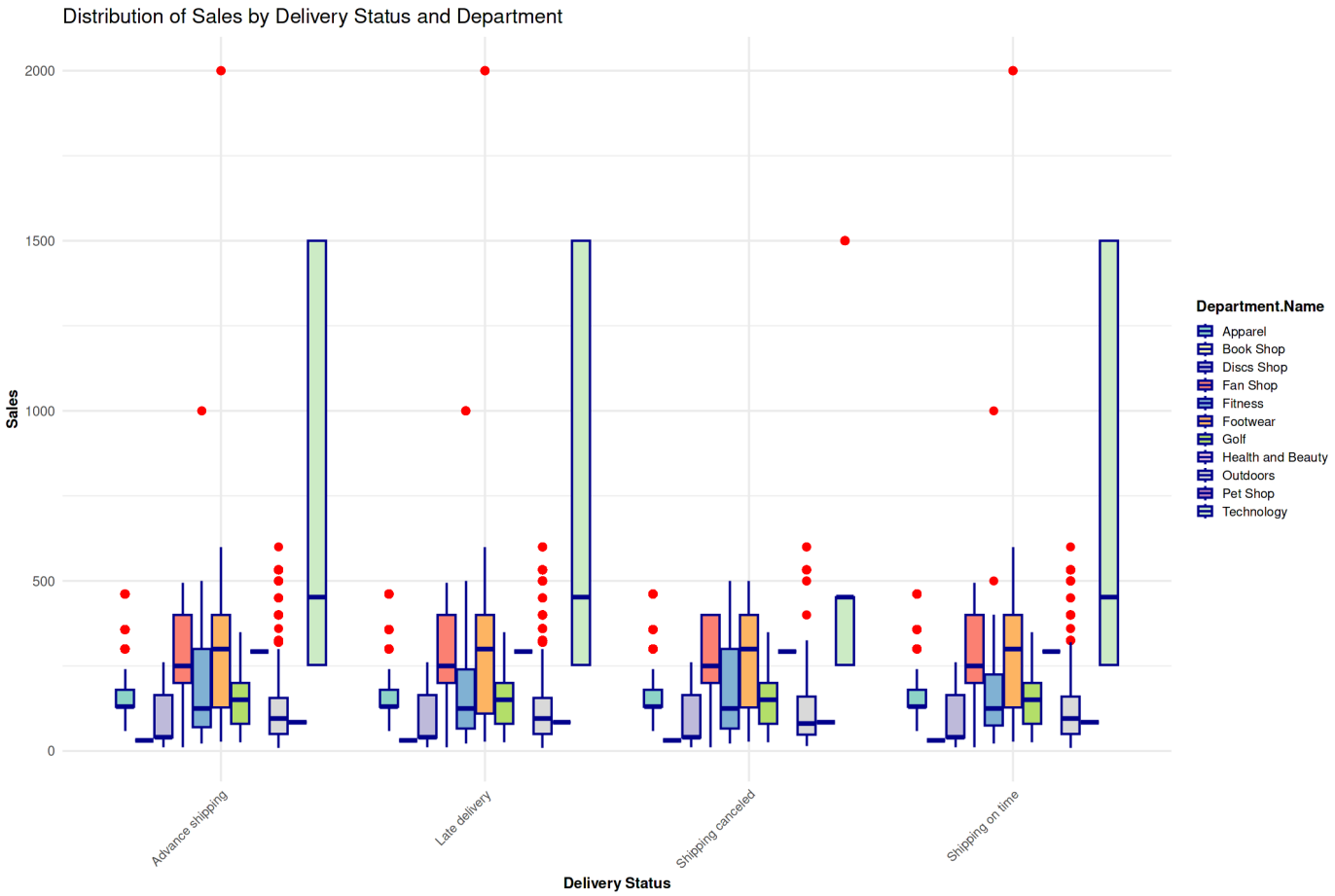
```r
# Boxplot for the distribution of sales by delivery status
ggplot(df, aes(x = Delivery.Status, y = Sales)) +
  geom_boxplot(fill = "skyblue", color = "darkblue", outlier.colour = "red", outlier.siz
  labs(title = "Distribution of Sales by Delivery Status",
       x = "Delivery Status",
       y = "Sales") +
  theme_minimal(base_size = 15) +  # Increased font size for better readability
  theme(axis.text.x = element_text(angle = 45, hjust = 1, size = 12),  # Adjusted angle
```

```
        axis.title.x = element_text(size = 14, face = "bold"),
        axis.title.y = element_text(size = 14, face = "bold"))   # Bold axis titles for e
```



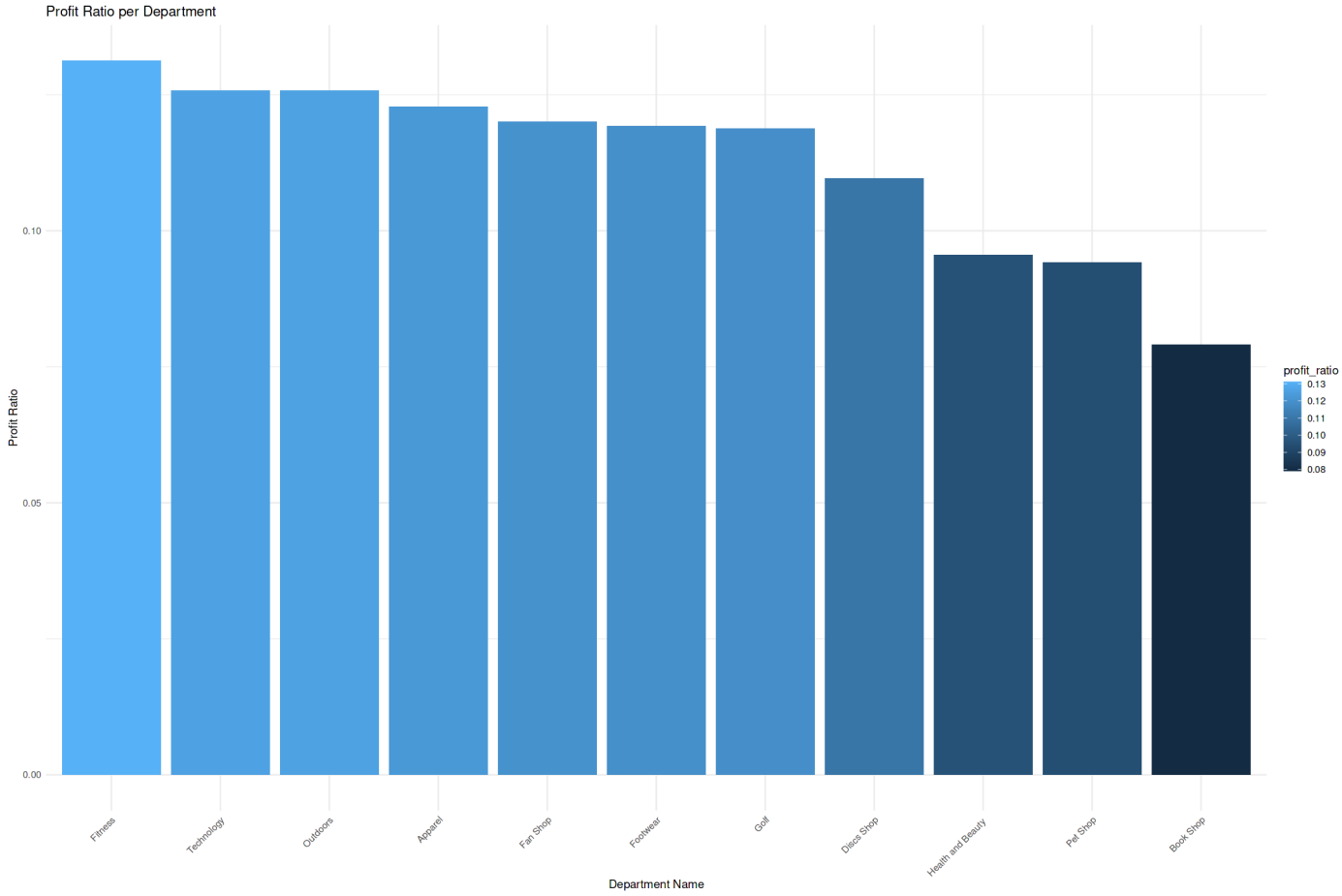
1. **Find Distribution of Sales by Delivery Status and Department.**

In [52]:
```
# Boxplot for the distribution of sales by delivery status and department
ggplot(df, aes(x = Delivery.Status, y = Sales, fill = Department.Name)) +
  geom_boxplot(outlier.colour = "red", position = position_dodge(0.8),
               outlier.size = 3,  # Enhance visibility of outliers
               lwd = 0.8, color = "darkblue") +  # Added outline color for boxplot for b
  labs(title = "Distribution of Sales by Delivery Status and Department",
       x = "Delivery Status",
       y = "Sales") +
  theme_minimal(base_size = 16) +  # Larger base font for better readability
  theme(axis.text.x = element_text(angle = 45, hjust = 1, size = 12),  # Rotate x-axis l
        axis.title.x = element_text(size = 14, face = "bold"),
        axis.title.y = element_text(size = 14, face = "bold"),
        legend.title = element_text(size = 14, face = "bold"),
        legend.text = element_text(size = 12)) +  # Styled legend text
  scale_fill_brewer(palette = "Set3")  # Added color palette for better visualization
```



1. **Find Profit Ratio per Department Name.**

In [53]:
```
# Calculate the mean Profit Ratio per Department
department_profit_ratio <- df %>%
  group_by(Department.Name) %>%
  summarise(profit_ratio = mean(Order.Item.Profit.Ratio, na.rm = TRUE))  # Calculate mea

# Create a bar plot for Profit Ratio per Department
ggplot(department_profit_ratio, aes(x = reorder(Department.Name, -profit_ratio), y = pro
  geom_bar(stat = "identity") +  # Create a bar for each department
  labs(title = "Profit Ratio per Department", x = "Department Name", y = "Profit Ratio")
  theme_minimal() +  # Use a minimal theme for better visuals
  theme(axis.text.x = element_text(angle = 45, hjust = 1))  # Rotate x-axis labels for b
```



Key Insights and Metrics

1. **Transaction Types Distribution**:

   - **CASH**: 10.9% of transactions (19,616).
   - **DEBIT**: 38.4% of transactions (69,295).
   - **PAYMENT**: 23.1% of transactions (41,725).
   - **TRANSFER**: 27.6% of transactions (49,883).
   - **Conclusion**: DEBIT transactions are the most common, accounting for nearly 40%, while CASH transactions have the lowest representation.
   - **Recommendation**: Focus on optimizing DEBIT transactions by improving customer experiences such as seamless payments and loyalty programs for frequent users.

2. **Delivery Status Analysis**:

   - **Late Delivery**: 54.8% of transactions (98,977) dominate delivery statuses.
   - **Advance Shipping**: 23% of transactions (41,592).
   - **Shipping Canceled**: 4.3% of transactions (7,754).
   - **Shipping on Time**: 17.8% of transactions (32,196).
   - **Conclusion**: Late deliveries account for over half of all deliveries, significantly impacting customer satisfaction.
   - **Recommendation**: Address late delivery issues by enhancing supply chain efficiency and real-time delivery tracking to improve customer satisfaction.

3. **Shipping Modes Distribution**:

   - **Standard Class**: Most frequently used (59.7% of transactions, 107,752).
   - **Second Class**: 19.5% of transactions (35,216).

- **First Class**: 15.4% of transactions (27,814).
- **Same Day**: Least frequent (5.39%, 9,737).
- **Conclusion**: Standard Class is the dominant shipping mode, with Same Day being underutilized.
- **Recommendation**: Increase incentives for premium shipping modes like Same Day to reduce late delivery risks and attract time-sensitive customers.

4. **Late Delivery by Category**:

   - **Top Categories with Late Deliveries**: Cleats (13,496), Men's Footwear (12,121), Women's Apparel (11,478).
   - **Conclusion**: Fashion and footwear items face the highest late delivery risks.
   - **Recommendation**: Optimize inventory and logistics for these high-risk categories by leveraging predictive demand forecasting and enhancing supplier coordination.

5. **Countries with the Highest Average Sales per Customer**:

   - **Estados Unidos (EE. UU.)**: Average sales of $183.03.
   - **Puerto Rico**: Average sales of $183.23.
   - **Conclusion**: Both EE. UU. and Puerto Rico exhibit high average sales, suggesting strong customer engagement in these regions.
   - **Recommendation**: Allocate resources to strengthen customer relationships in these countries through tailored campaigns and exclusive offers.

6. **Customer Segment Contribution to Profit**:

   - **Highest Contributor**: Consumer segment ($2,073,487.67 in profit).
   - **Conclusion**: Consumer customers significantly drive profitability.
   - **Recommendation**: Expand personalized marketing strategies and loyalty programs for this segment to maintain and grow profitability.

7. **Average Sales per Customer by Segment**:

   - **Consumer**: $183.57.
   - **Corporate**: $183.08.
   - **Home Office**: $181.82.
   - **Conclusion**: Consumer customers yield the highest average sales, with Home Office customers slightly lagging.
   - **Recommendation**: Focus on boosting sales from Home Office customers through targeted discounts and specialized offerings.

8. **States with the Highest Sales per Customer**:

   - **Top State**: Alabama ($222.55 per customer).
   - **Conclusion**: Alabama demonstrates the highest customer spending, likely due to higher purchasing power or demand for specific products.
   - **Recommendation**: Explore similar opportunities in other high-potential states and replicate successful strategies from Alabama.

9. **Customer Segments with the Highest Late Delivery Risk**:

   - **Highest Risk Segment**: Home Office (55.07%).
   - **Conclusion**: Home Office customers face the highest late delivery risk, which could negatively impact retention.
   - **Recommendation**: Prioritize improving delivery reliability for Home Office custill address inefficiencies, improve customer satisfaction, and increase profitability.

Conclusions

- **Performance Gaps**: Late deliveries are a critical issue, affecting over 50% of shipments and the Home Office segment disproportionately.
- **Transaction Insights**: DEBIT transactions and Standard Class shipping dominate the business but may require better support to enhance user satisfaction.
- **Regional Focus**: Estados Unidos, Puerto Rico, and Alabama emerge as higrforming regions/states in terms of sales per customer.

Recommendations

1. **Improve Delivery Performance**:
    - Enhance supply chain processes to reduce late deliveries.
    - Offer delivery guarantees or compensation for delayed shipments to rebuild trust.
2. **Leverage Profitable Customer Segments**:
    - Prioritize personalized experiences for Consumer and Corporate segments to maximize revenue.
    - Increase engagement with high-sales regions such as EE. UU. and Puerto Rico.
3. **Adopt Data-Driven Marketing**:
    - Use insights from transaction types, shipping modes, and delivery statuses to design targeted campaigns.
    - Focus on converting low-performing segments like Home Office into high-value customers.
4. **Optimize Shipping Modes**:
    - Offer discounts or incentives for Same Day and First Class shipping to encourage premium options.
    - Invest in logistics infrastructure to support faster delivery modes.
5. **Focus on High-Risk Categories**:
    - Use predictive analytics to ensure timely inventory replenishmenps will address inefficiencies, improve customer satisfaction, and increase profitability.

Connect & Follow

If you found my project insightful, I'd love to connect! I'm passionate about creating impactful data-driven solutions like this one to drive success. Follow me for more updates on my projects and insights. Let's collaborate and grow together!

Lakshmi Kant

Data Scientist | Data Analyst | SEO Analyst

- Linkedin: https://www.linkedin.com/in/kant-ai/
- Portfolio: https://genrix.netlify.app/
- GitHub: https://github.com/genrix-ai