Data Visualisation with R - Project

AfterWork Data Science: Data Visualisation with R Project

1. Defining the Question

a) Specifying the Data Analysis Question

Specify the reasearch question that you'll be answering. i.e. Provide strategy recommendations that will lead to revenue growth.

b) Defining the Metric for Success

The solutions to the following questions will help us answer our research question:

- When is the best time of year to book a hotel room?
- When is the optimal length of stay in order to get the best daily rate?
- How will you know if a hotel was likely to receive a disproportionately high number of special requests?

c) Understanding the context

Provide some background information....

d) Recording the Experimental Design

Describe the steps/approach that you will use to answer the given question.

e) Data Relevance

How relevant was the provided data?

2. Reading the Data

```
library(readr)
hotel_bookings <- read_csv("hotel_bookings.csv")</pre>
## Rows: 119390 Columns: 32
## -- Column specification -----
## Delimiter: ","
## chr (13): hotel, arrival_date_month, meal, country, market_segment, distrib...
## dbl (18): is_canceled, lead_time, arrival_date_year, arrival_date_week_numb...
## date (1): reservation_status_date
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
# Checking the first 5 rows of data
# ---
# YOUR CODE GOES BELOW
head(hotel_bookings, 5)
## # A tibble: 5 x 32
                  is_canceled lead_time arrival_date_year arrival_date_month
##
    hotel
##
     <chr>
                        <dbl>
                                  <dbl>
                                                    <dbl> <chr>
## 1 Resort Hotel
                         0
                                    342
                                                     2015 July
## 2 Resort Hotel
                           0
                                    737
                                                     2015 July
## 3 Resort Hotel
                           0
                                     7
                                                     2015 July
## 4 Resort Hotel
                            0
                                     13
                                                     2015 July
## 5 Resort Hotel
                            0
                                     14
                                                     2015 July
## # i 27 more variables: arrival_date_week_number <dbl>,
      arrival_date_day_of_month <dbl>, stays_in_weekend_nights <dbl>,
## #
      stays_in_week_nights <dbl>, adults <dbl>, children <dbl>, babies <dbl>,
## #
      meal <chr>, country <chr>, market segment <chr>,
      distribution_channel <chr>, is_repeated_guest <dbl>,
       previous_cancellations <dbl>, previous_bookings_not_canceled <dbl>,
## #
      reserved_room_type <chr>, assigned_room_type <chr>, ...
head(hotel bookings,5)
## # A tibble: 5 x 32
##
                 is_canceled lead_time arrival_date_year arrival_date_month
    hotel
     <chr>>
                       <dbl>
                                <dbl>
                                                   <dbl> <chr>
## 1 Resort Hotel
                                    342
                                                     2015 July
                           0
## 2 Resort Hotel
                           0
                                    737
                                                     2015 July
## 3 Resort Hotel
                           0
                                      7
                                                     2015 July
## 4 Resort Hotel
                           Ω
                                     13
                                                     2015 July
## 5 Resort Hotel
                           0
                                     14
                                                     2015 July
## # i 27 more variables: arrival_date_week_number <dbl>,
      arrival date day of month <dbl>, stays in weekend nights <dbl>,
## #
      stays_in_week_nights <dbl>, adults <dbl>, children <dbl>, babies <dbl>,
      meal <chr>, country <chr>, market_segment <chr>,
## #
      distribution_channel <chr>, is_repeated_guest <dbl>,
## #
      previous_cancellations <dbl>, previous_bookings_not_canceled <dbl>,
## #
      reserved_room_type <chr>, assigned_room_type <chr>, ...
```

#print(hotel_bookings)

```
# Checking the first 5 rows of data
# ---
# YOUR CODE GOES BELOW
#
head(hotel_bookings,5)
## # A tibble: 5 x 32
##
    hotel
                  is_canceled lead_time arrival_date_year arrival_date_month
##
     <chr>>
                        <dbl>
                                  <dbl>
                                                     <dbl> <chr>
## 1 Resort Hotel
                            0
                                    342
                                                      2015 July
## 2 Resort Hotel
                            0
                                    737
                                                      2015 July
## 3 Resort Hotel
                            0
                                      7
                                                      2015 July
## 4 Resort Hotel
                                     13
                                                      2015 July
## 5 Resort Hotel
                            0
                                     14
                                                      2015 July
## # i 27 more variables: arrival_date_week_number <dbl>,
       arrival_date_day_of_month <dbl>, stays_in_weekend_nights <dbl>,
       stays_in_week_nights <dbl>, adults <dbl>, children <dbl>, babies <dbl>,
## #
       meal <chr>, country <chr>, market_segment <chr>,
## #
       distribution_channel <chr>, is_repeated_guest <dbl>,
       previous_cancellations <dbl>, previous_bookings_not_canceled <dbl>,
      reserved_room_type <chr>, assigned_room_type <chr>, ...
# Checking the last 5 rows of data
# ---
# YOUR CODE GOES BELOW
tail(hotel_bookings, 5)
## # A tibble: 5 x 32
            is_canceled lead_time arrival_date_year arrival_date_month
##
     <chr>>
                      <dbl>
                                <dbl>
                                                   <dbl> <chr>
## 1 City Hotel
                                                    2017 August
                          0
                          0
## 2 City Hotel
                                  102
                                                    2017 August
## 3 City Hotel
                          0
                                   34
                                                    2017 August
## 4 City Hotel
                          0
                                  109
                                                    2017 August
## 5 City Hotel
                          0
                                  205
                                                    2017 August
## # i 27 more variables: arrival_date_week_number <dbl>,
      arrival_date_day_of_month <dbl>, stays_in_weekend_nights <dbl>,
       stays_in_week_nights <dbl>, adults <dbl>, children <dbl>, babies <dbl>,
## #
## #
      meal <chr>, country <chr>, market_segment <chr>,
       distribution_channel <chr>, is_repeated_guest <dbl>,
       previous_cancellations <dbl>, previous_bookings_not_canceled <dbl>,
       reserved_room_type <chr>, assigned_room_type <chr>, ...
#print(hotel bookings)
# Sample 10 rows of data
# YOUR CODE GOES BELOW
library(dplyr)
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##
       filter, lag
## The following objects are masked from 'package:base':
##
##
       intersect, setdiff, setequal, union
set.seed(123) # Set seed for reproducibility
hotel_bookings %>% sample_n(10)
## # A tibble: 10 x 32
##
     hotel
                   is_canceled lead_time arrival_date_year arrival_date_month
##
      <chr>
                         <dbl>
                                   <dbl>
                                                      <dbl> <chr>
## 1 City Hotel
                             1
                                     158
                                                      2016 May
## 2 City Hotel
                             1
                                      81
                                                       2016 October
## 3 Resort Hotel
                             0
                                      79
                                                      2015 November
                                      49
## 4 Resort Hotel
                             0
                                                      2016 November
## 5 City Hotel
                             0
                                       9
                                                       2016 August
## 6 City Hotel
                             0
                                       4
                                                      2016 December
## 7 City Hotel
                             1
                                     104
                                                      2017 May
                                     253
## 8 City Hotel
                                                      2017 January
                             1
## 9 City Hotel
                             0
                                      72
                                                       2015 October
                                      38
                                                       2017 March
## 10 City Hotel
                             1
## # i 27 more variables: arrival date week number <dbl>,
       arrival_date_day_of_month <dbl>, stays_in_weekend_nights <dbl>,
       stays_in_week_nights <dbl>, adults <dbl>, children <dbl>, babies <dbl>,
## #
## #
      meal <chr>, country <chr>, market_segment <chr>,
       distribution_channel <chr>, is_repeated_guest <dbl>,
       previous_cancellations <dbl>, previous_bookings_not_canceled <dbl>,
## #
       reserved_room_type <chr>, assigned_room_type <chr>, ...
# Checking number of rows and columns
# YOUR CODE GOES BELOW
exists("hotel_bookings") # checking in the file exists
## [1] TRUE
print(paste("Printing nrow and ncol:", dim(hotel_bookings)))
## [1] "Printing nrow and ncol: 119390" "Printing nrow and ncol: 32"
print(paste('Printing nrow:', nrow(hotel_bookings)))
## [1] "Printing nrow: 119390"
print(paste('Printing ncol:',ncol(hotel_bookings)))
## [1] "Printing ncol: 32"
# Checking datatypes
# ---
# YOUR CODE GOES BELOW
str(hotel_bookings)
```

```
## spc_tbl_ [119,390 x 32] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
## $ hotel
                                                           : chr [1:119390] "Resort Hotel" "Res
## $ is canceled
                                                           : num [1:119390] 0 0 0 0 0 0 0 1 1 ...
                                                            : num [1:119390] 342 737 7 13 14 14 0 9 85 75 ...
## $ lead_time
## $ arrival_date_year
                                                           : num [1:119390] 2015 2015 2015 2015 2015 ...
## $ arrival date month
                                                           : chr [1:119390] "July" "July" "July" "July" ...
                                                           : num [1:119390] 27 27 27 27 27 27 27 27 27 27 ...
## $ arrival_date_week_number
## $ arrival_date_day_of_month
                                                           : num [1:119390] 1 1 1 1 1 1 1 1 1 1 ...
      $ stays_in_weekend_nights
                                                           : num [1:119390] 0 0 0 0 0 0 0 0 0 0 ...
                                                           : num [1:119390] 0 0 1 1 2 2 2 2 3 3 ...
## $ stays_in_week_nights
## $ adults
                                                            : num [1:119390] 2 2 1 1 2 2 2 2 2 2 ...
## $ children
                                                            : num [1:119390] 0 0 0 0 0 0 0 0 0 0 ...
## $ babies
                                                           : num [1:119390] 0 0 0 0 0 0 0 0 0 0 ...
## $ meal
                                                           : chr [1:119390] "BB" "BB" "BB" "BB" ...
## $ country
                                                           : chr [1:119390] "PRT" "PRT" "GBR" "GBR" ...
## $ market_segment
                                                           : chr [1:119390] "Direct" "Direct" "Direct" "Corporate" ...
                                                          : chr [1:119390] "Direct" "Direct" "Direct" "Corporate" ...
## $ distribution_channel
                                                          : num [1:119390] 0 0 0 0 0 0 0 0 0 0 ...
## $ is_repeated_guest
                                                           : num [1:119390] 0 0 0 0 0 0 0 0 0 0 ...
## $ previous_cancellations
## $ previous_bookings_not_canceled: num [1:119390] 0 0 0 0 0 0 0 0 0 0 ...
## $ reserved_room_type
                                                          : chr [1:119390] "C" "C" "A" "A" ...
## $ assigned_room_type
                                                           : chr [1:119390] "C" "C" "C" "A" ...
                                                           : num [1:119390] 3 4 0 0 0 0 0 0 0 0 ...
## $ booking_changes
                                                           : chr [1:119390] "No Deposit" "No Deposit" "No Deposit" "No Deposit"
## $ deposit_type
                                                           : chr [1:119390] "NULL" "NULL" "NULL" "304" ...
## $ agent
## $ company
                                                           : chr [1:119390] "NULL" "NULL" "NULL" "NULL" ...
## $ days_in_waiting_list
                                                           : num [1:119390] 0 0 0 0 0 0 0 0 0 0 ...
                                                           : chr [1:119390] "Transient" "Transient" "Transient" "Transient" ...
## $ customer_type
## $ adr
                                                            : num [1:119390] 0 0 75 75 98 ...
                                                           : num [1:119390] 0 0 0 0 0 0 0 0 0 0 ...
## $ required_car_parking_spaces
                                                           : num [1:119390] 0 0 0 0 1 1 0 1 1 0 ...
## $ total_of_special_requests
                                                           : chr [1:119390] "Check-Out" "Check-Out" "Check-Out" "Check-Out" \hdots
## $ reservation_status
                                                         : Date[1:119390], format: "2015-07-01" "2015-07-01" ...
## $ reservation_status_date
     - attr(*, "spec")=
##
##
        .. cols(
##
                hotel = col_character(),
##
                is_canceled = col_double(),
##
                lead_time = col_double(),
##
             arrival_date_year = col_double(),
        . .
##
            arrival_date_month = col_character(),
##
            arrival_date_week_number = col_double(),
##
               arrival_date_day_of_month = col_double(),
                stays_in_weekend_nights = col_double(),
##
##
               stays_in_week_nights = col_double(),
               adults = col_double(),
##
               children = col_double(),
##
                babies = col_double(),
        . .
##
                meal = col_character(),
##
               country = col_character(),
##
                market_segment = col_character(),
##
               distribution_channel = col_character(),
        . .
##
        .. is_repeated_guest = col_double(),
##
        .. previous_cancellations = col_double(),
```

previous_bookings_not_canceled = col_double(),

##

```
##
          reserved_room_type = col_character(),
##
          assigned_room_type = col_character(),
##
          booking changes = col double(),
     . .
          deposit_type = col_character(),
##
##
          agent = col_character(),
##
          company = col character(),
          days in waiting list = col double(),
##
          customer_type = col_character(),
##
##
          adr = col_double(),
##
          required_car_parking_spaces = col_double(),
##
          total_of_special_requests = col_double(),
          reservation_status = col_character(),
##
          reservation_status_date = col_date(format = "")
##
##
    - attr(*, "problems")=<externalptr>
```

colnames(hotel_bookings)

```
[1] "hotel"
                                          "is_canceled"
##
                                          "arrival_date_year"
##
    [3] "lead_time"
                                          "arrival_date_week_number"
    [5] "arrival_date_month"
                                          "stays_in_weekend_nights"
##
        "arrival_date_day_of_month"
##
    [9] "stays_in_week_nights"
                                          "adults"
## [11] "children"
                                          "babies"
## [13] "meal"
                                          "country"
## [15] "market_segment"
                                          "distribution_channel"
## [17] "is_repeated_guest"
                                          "previous cancellations"
## [19] "previous bookings not canceled"
                                          "reserved room type"
## [21] "assigned_room_type"
                                          "booking_changes"
## [23] "deposit type"
                                          "agent"
## [25] "company"
                                          "days_in_waiting_list"
                                          "adr"
  [27] "customer_type"
  [29] "required_car_parking_spaces"
                                          "total_of_special_requests"
   [31] "reservation status"
                                          "reservation status date"
```

Record your general observations below:

Observation 1 Observation 2

The dataset contains 119,390 rows and 32 columns with a variety of information about hotel bookings, such as cancellation status, lead time, arrival dates, etc.

The dataset includes different data types: character (chr), numeric (dbl), and date.

Some columns have **missing values** (Null Values), such as the **agent** and **company** columns. It's important to handle these missing values carefully, either by **imputation** (filling missing data with a calculated value) or **exclusion** (removing rows with missing values).

Additionally, some columns need to be **converted into the correct type** for proper analysis. For example, the **children**, **adults**, and **babies** columns should be converted into integers, as they currently might be in character or numeric formats.

To better answer questions related to **cancellation prediction** or **customer behavior analysis**, we may need additional relevant data points, such as **customer reviews**, **prices**, for each booking. These columns are missing from the dataset but could be vital for improving the analysis.

3. External Data Source Validation

The data is originally from the article Hotel Booking Demand Datasets, by Nuno Antonio, Ana Almeida, and Luis Nunes for Data in Brief, Volume 22, February 2019.

4. Data Preparation

Performing Data Cleaning

```
# Checking datatypes and missing entries of all the variables
# YOUR CODE GOES BELOW
#print(paste('printing the datatypes of the column hotel:',typeof(hotel_bookings$hotel)))
#print(paste('Printing column names:',colnames(hotel_bookings)))
#Checking datatypes
sapply(hotel_bookings, class)
##
                             hotel
                                                        is_canceled
##
                       "character"
                                                          "numeric"
##
                         lead time
                                                 arrival_date_year
                         "numeric"
                                                          "numeric"
##
##
               arrival_date_month
                                          arrival_date_week_number
##
                       "character"
                                                          "numeric"
        arrival_date_day_of_month
##
                                           stays_in_weekend_nights
##
                         "numeric"
                                                          "numeric"
##
             stays in week nights
                                                             adults
##
                         "numeric"
                                                          "numeric"
##
                          children
                                                             babies
##
                         "numeric"
                                                          "numeric"
##
                              meal
                                                            country
##
                       "character"
                                                        "character"
##
                    market_segment
                                              distribution channel
##
                       "character"
                                                        "character"
##
                 is_repeated_guest
                                            previous_cancellations
##
                         "numeric"
                                                          "numeric"
   previous_bookings_not_canceled
                                                reserved_room_type
##
                                                        "character"
##
                         "numeric"
##
               assigned_room_type
                                                    booking changes
                                                          "numeric"
##
                       "character"
##
                      deposit_type
                                                              agent
                                                        "character"
##
                       "character"
                                              days_in_waiting_list
##
                           company
##
                       "character"
                                                          "numeric"
##
                                                                adr
                     customer_type
                                                          "numeric"
##
                       "character"
##
      required_car_parking_spaces
                                         total_of_special_requests
                                                          "numeric"
##
                         "numeric"
##
               reservation_status
                                           reservation_status_date
##
                       "character"
                                                             "Date"
#str(hotel_bookings)
```

```
#missing entries of all the variables
colSums(is.na(hotel bookings))
##
                             hotel
                                                        is_canceled
##
                                  0
##
                         lead_time
                                                  arrival_date_year
##
                                          arrival_date_week_number
##
               arrival_date_month
##
        arrival_date_day_of_month
##
                                           stays_in_weekend_nights
##
##
                                                             adults
             stays_in_week_nights
##
##
                          children
                                                             babies
##
                              meal
##
                                                            country
##
##
                    market_segment
                                              distribution_channel
##
##
                 is_repeated_guest
                                            previous_cancellations
##
##
   previous_bookings_not_canceled
                                                 reserved_room_type
##
##
                assigned_room_type
                                                    booking_changes
##
                      deposit_type
##
                                                               agent
##
                                                                   0
##
                           company
                                               days_in_waiting_list
##
##
                     customer_type
                                                                 adr
##
                                                                   0
##
      required_car_parking_spaces
                                         total_of_special_requests
##
##
                reservation_status
                                           reservation_status_date
##
                                  0
                                                                   0
```

[1] 4

We observe the following from our dataset:

The childrens columns has the most missing entries with a total of 4(PS: we did not consider the NULL entries)

The data type has been discussed above

Observation 1 Observation 2

sum(is.na(hotel_bookings))

```
# Checking how many duplicate rows are there in the data
# ---
# YOUR CODE GOES BELOW
#
```

```
duplicated_rows <- (duplicated(hotel_bookings))

#print(duplicated_rows)
print(sum(duplicated_rows))

## [1] 31994

duplicate_rows <- hotel_bookings[duplicated(hotel_bookings), ]
#print(duplicate_rows)</pre>
```

We choose to keep the duplicates because we don't have a unique identifier to actually proof that we have duplicates.

```
# Checking if any of the columns are all null
# ---
# YOUR CODE GOES BELOW
#
#
colSums(is.na(hotel_bookings)) == nrow(hotel_bookings)
```

```
##
                                                         is_canceled
                              hotel
##
                              FALSE
                                                               FALSE
##
                          lead_time
                                                  arrival_date_year
##
                              FALSE
                                                               FALSE
##
                arrival_date_month
                                           arrival_date_week_number
##
                              FALSE
                                                               FALSE
##
        arrival_date_day_of_month
                                            stays_in_weekend_nights
##
                              FALSE
                                                               FALSE
##
              stays_in_week_nights
                                                               adults
##
                              FALSE
                                                               FALSE
                           children
                                                              babies
##
##
                              FALSE
                                                               FALSE
##
                               meal
                                                             country
##
                              FALSE
                                                               FALSE
##
                    market_segment
                                               distribution_channel
##
                              FALSE
                                                               FALSE
##
                 is_repeated_guest
                                             previous_cancellations
##
                              FALSE
                                                               FALSE
##
   previous_bookings_not_canceled
                                                 reserved_room_type
##
                              FALSE
                                                               FALSE
##
                assigned_room_type
                                                     booking_changes
##
                              FALSE
                                                               FALSE
##
                      deposit_type
                                                               agent
##
                                                               FALSE
                              FALSE
##
                            company
                                               days_in_waiting_list
##
                              FALSE
                                                               FALSE
##
                     customer_type
                                                                  adr
##
                                                               FALSE
                              FALSE
      {\tt required\_car\_parking\_spaces}
##
                                          total_of_special_requests
##
                              FALSE
                                                               FALSE
##
                reservation_status
                                            reservation_status_date
##
                              FALSE
                                                               FALSE
```

```
colnames(hotel_bookings)[colSums(is.na(hotel_bookings)) == nrow(hotel_bookings)]
```

character(0)

We observe the following from our dataset:

Observation 1

The data contains 31,987 duplicated rows (excluding the first occurrence) and does not have any column that is completely empty.

```
# Checking if any of the rows are all null
# ---
# YOUR CODE GOES BELOW
#
rowSums(is.na(hotel_bookings)) == ncol(hotel_bookings)
```

```
##
                                                                                                                                          [1] FALSE FA
##
                                                                                                                         [13] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
                                                                                                                         [25] FALSE F
##
                                                                                                                         [37] FALSE F
##
                                                                                                                         [49] FALSE F
##
                                                                                                                         [61] FALSE F
##
##
                                                                                                                         [73] FALSE F
                                                                                                                       [85] FALSE F
##
##
                                                                                                                         [97] FALSE FALSE
                                                                                                      [109] FALSE 
##
##
                                                                                                   [121] FALSE 
##
                                                                                                   [133] FALSE 
                                                                                                   [145] FALSE 
##
##
                                                                                                   [157] FALSE 
                                                                                                   [169] FALSE 
##
##
                                                                                                   [181] FALSE FALSE
##
                                                                                                   [193] FALSE 
                                                                                                      [205] FALSE FALSE
##
                                                                                                   [217] FALSE 
##
                                                                                                   [229] FALSE 
##
                                                                                                   [241] FALSE 
##
##
                                                                                                   [253] FALSE 
##
                                                                                                   [265] FALSE 
                                                                                                   [277] FALSE 
##
                                                                                                   [289] FALSE 
##
##
                                                                                                   [301] FALSE 
##
                                                                                                   [313] FALSE 
##
                                                                                                   [325] FALSE 
##
                                                                                                   [337] FALSE FALSE
                                                                                                   [349] FALSE 
##
                                                                                                   [361] FALSE 
##
                                                                                                      [373] FALSE FALSE
##
##
                                                                                                      [385] FALSE FALSE
                                                                                                   [397] FALSE FALSE
##
                                                                                                      [409] FALSE FALSE
##
                                                                                                   [421] FALSE 
##
                                                                                                   [433] FALSE 
##
                                                                                                   [445] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##
```

```
[457] FALSE 
##
##
                                                                                                                  [469] FALSE 
                                                                                                                  [481] FALSE 
##
                                                                                                                  [493] FALSE 
##
##
                                                                                                                  [505] FALSE 
                                                                                                                  [517] FALSE 
##
                                                                                                                  [529] FALSE FALSE
                                                                                                                  [541] FALSE 
##
##
                                                                                                                  [553] FALSE 
##
                                                                                                                  [565] FALSE 
##
                                                                                                                     [577] FALSE FALSE
                                                                                                                  [589] FALSE 
##
                                                                                                                  [601] FALSE 
##
                                                                                                                  [613] FALSE 
##
##
                                                                                                                  [625] FALSE 
                                                                                                                  [637] FALSE 
##
##
                                                                                                                  [649] FALSE 
                                                                                                                     [661] FALSE 
##
                                                                                                                  [673] FALSE 
##
                                                                                                                  [685] FALSE 
##
##
                                                                                                                  [697] FALSE FALSE
                                                                                                                  [709] FALSE 
##
                                                                                                                  [721] FALSE 
##
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## [94417] FALSE FALSE
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## [99961] FALSE F
## [99973] FALSE FALSE
## [99985] FALSE F
## [99997] FALSE FALSE FALSE
## [ reached getOption("max.print") -- omitted 19391 entries ]
hotel_bookings[rowSums(is.na(hotel_bookings)) == ncol(hotel_bookings), ]
## # A tibble: 0 x 32
## # i 32 variables: hotel <chr>, is_canceled <dbl>, lead_time <dbl>,
                                           arrival_date_year <dbl>, arrival_date_month <chr>,
                                           arrival_date_week_number <dbl>, arrival_date_day_of_month <dbl>,
## #
                                          stays_in_weekend_nights <dbl>, stays_in_week_nights <dbl>, adults <dbl>,
## #
                                          children <dbl>, babies <dbl>, meal <chr>, country <chr>,
## #
                                          market segment <chr>, distribution channel <chr>, is repeated guest <dbl>,
                                          previous_cancellations <dbl>, previous_bookings_not_canceled <dbl>, ...
```

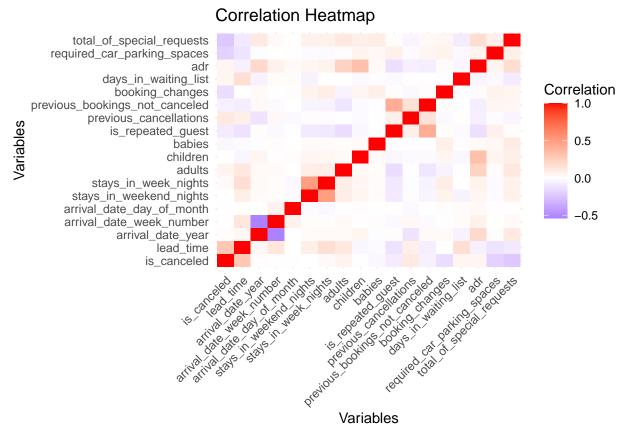
We observe the following from our dataset:

Observation 1 Observation 2

The data contains 31,987 duplicated rows (excluding the first occurrence) and does not have any rows that is completely empty.

```
#library(dplyr)
```

```
#install.packages("reshape2")
# Checking the correlation of the features through the use of
# visualizations the correlation using heatmap
# YOUR CODE GOES BELOW
# Load necessary libraries
library(dplyr)
library(ggplot2)
library(reshape2)
# Select numeric columns from the dataset
numeric_data <- hotel_bookings %>%
  select(where(is.numeric))
# Compute the correlation matrix
cor_matrix <- cor(numeric_data, use = "complete.obs")</pre>
# Reshape the correlation matrix to long format for ggplot
cor_matrix_melted <- melt(cor_matrix)</pre>
# Create heatmap using ggplot2
p <- ggplot(cor_matrix_melted, aes(Var1, Var2, fill = value)) +</pre>
  geom_tile() +
  scale_fill_gradient2(low = "blue", high = "red", mid = "white", midpoint = 0) +
  theme_minimal() +
  labs(title = "Correlation Heatmap",
      x = "Variables",
       y = "Variables",
       fill = "Correlation") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
# Save the figure
\#ggsave("correlation\_heatmap.png", plot = p, width = 8, height = 6, dpi = 300)
# Show the plot
print(p)
```



We observe the following from our dataset:

Observation 1 Observation 2

Strong Positive Correlations:

We observe a strong positive correlation between variables such as stays_in_week_nights and stays_in_weekend_nights, indicating that longer stays during weekdays are often associated with longer weekend stays.

Additionally, previous_bookings_not_canceled and is_repeated_guest also appear positively correlated, suggesting that repeated guests tend to have fewer cancellations in their booking history.

The heatmap shows a positive correlation between lead_time and is_canceled. This implies that bookings with longer lead times (i.e., made far in advance) are more likely to be canceled. This is a logical finding because guests who book far in advance may face changing circumstances that lead to cancellations.

Weak and no Correlation:

Variables such as arrival_date_day_of_month, arrival_date_week_number, and arrival_date_year show weak correlations with most other variables, suggesting that arrival date information does not strongly influence other factors, such as cancellations or booking behavior.

There is a week correlation between the lead time and adr

Potential Insights for Business Decisions:

is_canceled and lead_time (Positive Correlation): A positive correlation suggests that bookings made further in advance (longer lead times) are more likely to be canceled.

Business Insight: This is an important factor to consider. Customers who book far in advance may be more likely to find better deals elsewhere, change their plans, or simply forget about the booking.

Actionable Items: Consider implementing strategies to reduce cancellations for long lead times. This could involve sending reminder emails closer to the stay date, offering incentives for keeping the booking (e.g., a small discount on on-site services), and implementing stricter cancellation policies for very long lead times (but be transparent about this).

```
# Dropping company column because it has alot of missing values
# and we won't need to answer any of our questions
# ---
# YOUR CODE GOES BELOW
# I have to comment how I dropped the compagny column because it was given warning as it was not existi
"company" %in% colnames(hotel_bookings)
## [1] TRUE
#is.na(hotel_bookings$company)
#print(sum(is.na(hotel_bookings$company)))
#print(hotel_bookings$company)
print(ncol(hotel_bookings))
## [1] 32
#sum(hotel_bookings$company == "NULL")
#hotel_bookings$company <- NULL</pre>
print(ncol(hotel_bookings))
## [1] 32
"company" %in% colnames(hotel_bookings)
```

[1] TRUE

From the data variable description we see that the Distribution Channel categoricy that tells us about Booking distribution.

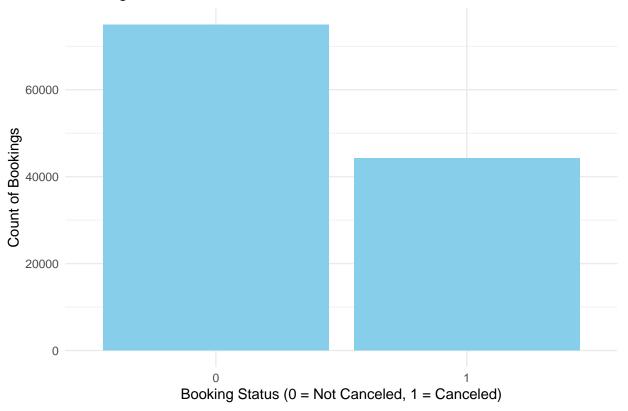
The term "TA" means "Travel Agents" The term "TO" means "Tour Operators" This allows us to fill the missing values in the agents column with TO

```
# We replace the mising values i.e. for TO
# ---
# YOUR GOES BELOW
#
#hotel_bookings$agent
unique1<-unique(hotel_bookings$agent)
#sum(is.na(hotel_bookings$agent))
#colnames(hotel_bookings)
#hotel_bookings$agent[is.na(hotel_bookings$agent)] <- 'TO'
hotel_bookings$agent[hotel_bookings$agent == "NULL"] <- "TO"
#print(hotel_bookings$agent)
# We drop rows where there is no adult, baby and child as
# these records won't help us.
# ---</pre>
```

```
# YOUR GOES BELOW
print(dim(hotel_bookings))
## [1] 119390
                                              32
hotel_bookings <- hotel_bookings[!(hotel_bookings$adults == 0 & hotel_bookings$babies == 0 & hotel_book
print(dim(hotel_bookings))
## [1] 119210
# We replace missing children values with rounded mean value
# Hint i.e. use round()
# YOUR GOES BELOW
mean_children <- mean(hotel_bookings$children, na.rm = TRUE)</pre>
print(mean_children)
## [1] 0.1040468
hotel_bookings$children[is.na(hotel_bookings$children)] <- round(mean_children)
print(hotel_bookings$children[hotel_bookings$children == mean_children])
## numeric(0)
#print(hotel_bookings$children)
print(typeof(hotel_bookings$children))
## [1] "double"
# Checking for missing values in the dataframe
# YOUR GOES BELOW
sum(is.na(hotel_bookings))
# Converting the datatypes of the following columns from float to integer
# i.e. children, company, agent
# ---
# YOUR GOES BELOW
hotel_bookings$children <- as.integer(hotel_bookings$children)
#hotel_bookings$company <- as.integer(hotel_bookings$company) this column has been remove above
hotel_bookings$agent <- as.integer(hotel_bookings$agent)</pre>
## Warning: NAs introduced by coercion
str(hotel_bookings)
## tibble [119,210 x 32] (S3: tbl_df/tbl/data.frame)
## $ hotel
                                                                                             : chr [1:119210] "Resort Hotel" "Res
```

```
## $ is_canceled
                                  : num [1:119210] 0 0 0 0 0 0 0 0 1 1 ...
## $ lead_time
                                  : num [1:119210] 342 737 7 13 14 14 0 9 85 75 ...
## $ arrival_date_year
                                  : num [1:119210] 2015 2015 2015 2015 2015 ...
                                  : chr [1:119210] "July" "July" "July" "July" ...
## $ arrival_date_month
## $ arrival_date_week_number
                                  : num [1:119210] 27 27 27 27 27 27 27 27 27 27 ...
                                 : num [1:119210] 1 1 1 1 1 1 1 1 1 1 ...
## $ arrival date day of month
## $ stays_in_weekend_nights
                                 : num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
                                   : num [1:119210] 0 0 1 1 2 2 2 2 3 3 ...
## $ stays_in_week_nights
## $ adults
                                   : num [1:119210] 2 2 1 1 2 2 2 2 2 2 ...
## $ children
                                  : int [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
## $ babies
                                  : num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
                                  : chr [1:119210] "BB" "BB" "BB" "BB" ...
## $ meal
                                  : chr [1:119210] "PRT" "PRT" "GBR" "GBR" ...
## $ country
                                 : chr [1:119210] "Direct" "Direct" "Direct" "Corporate" ...
## $ market_segment
                                 : chr [1:119210] "Direct" "Direct" "Direct" "Corporate" ...
## $ distribution_channel
## $ is_repeated_guest
                                  : num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
## $ previous_cancellations : num [1:119210] 0 0 0 0 0 0 0 0 0 ...
## $ previous_bookings_not_canceled: num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
                                 : chr [1:119210] "C" "C" "A" "A" ...
## $ reserved_room_type
                                  : chr [1:119210] "C" "C" "C" "A" ...
## $ assigned_room_type
## $ booking_changes
                                  : num [1:119210] 3 4 0 0 0 0 0 0 0 0 ...
## $ deposit_type
                                  : chr [1:119210] "No Deposit" "No Deposit" "No Deposit" "No Deposit
## $ agent
                                  : int [1:119210] NA NA NA 304 240 240 NA 303 240 15 ...
                                  : chr [1:119210] "NULL" "NULL" "NULL" "NULL" ...
## $ company
                                  : num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
## $ days_in_waiting_list
                                  : chr [1:119210] "Transient" "Transient" "Transient" "Transient" ...
## $ customer_type
## $ adr
                                   : num [1:119210] 0 0 75 75 98 ...
## $ required_car_parking_spaces : num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
## $ total_of_special_requests : num [1:119210] 0 0 0 0 1 1 0 1 1 0 ...
                                   : chr [1:119210] "Check-Out" "Check-Out" "Check-Out" "Check-Out" ...
## $ reservation_status
## $ reservation_status_date
                                   : Date[1:119210], format: "2015-07-01" "2015-07-01" ...
library(dplyr)
library(ggplot2)
# Summarize the count of canceled and non-canceled bookings
cancelled_count <- hotel_bookings %>%
  group_by(is_canceled) %>%
  summarise(count = n())
# Create a barplot to visualize the count of canceled and non-canceled bookings
p<-ggplot(cancelled_count, aes(x = factor(is_canceled), y = count)) +</pre>
  geom_bar(stat = "identity", fill = "skyblue") +
  labs(title = "Bookings Canceled vs Not Canceled",
      x = "Booking Status (0 = Not Canceled, 1 = Canceled)",
      y = "Count of Bookings") +
  theme_minimal()
# Print the plot
print(p)
```

Bookings Canceled vs Not Canceled

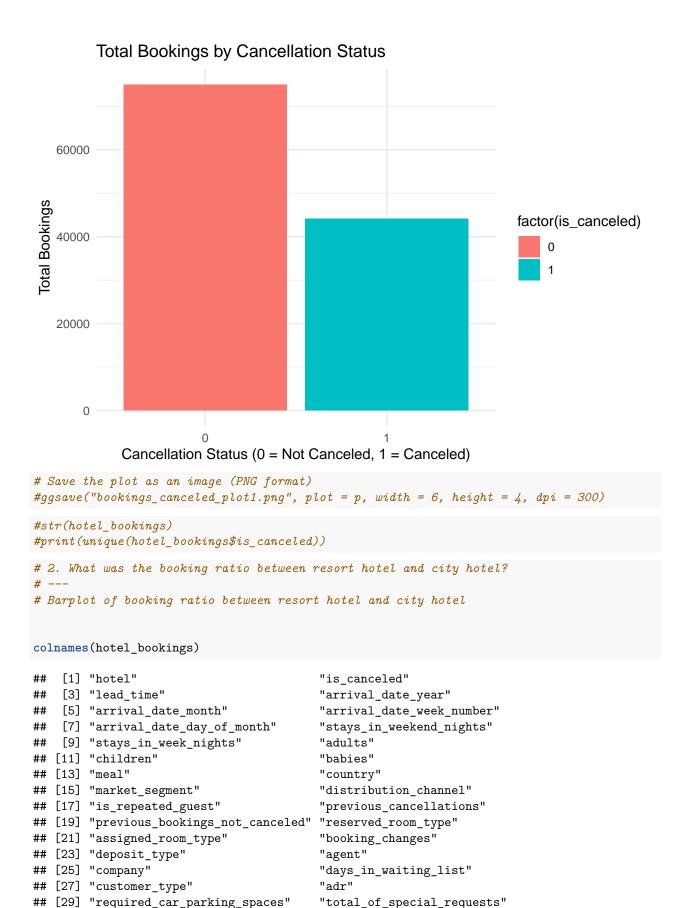


```
# Save the plot as an image (PNG format)
#ggsave("bookings_canceled_plot.png", plot = p, width = 6, height = 4, dpi = 300)
```

5. Solution Implementation

5.a) Questions

```
# 1. How many bookings were cancelled?
# Visualisation: Barplot
library(ggplot2)
library(dplyr)
# Summarize booking data by hotel and cancellation status
booking_counts <- hotel_bookings %>%
  group_by(hotel, is_canceled) %>%
  summarise(count = n(), .groups = "drop")
# Plot the data
p<-ggplot(booking_counts, aes(x = factor(is_canceled), y = count, fill = factor(is_canceled))) +</pre>
  geom_bar(stat = "identity") +
  labs(title = "Total Bookings by Cancellation Status",
       x = "Cancellation Status (0 = Not Canceled, 1 = Canceled)",
       y = "Total Bookings") +
  theme_minimal()
# Print the plot
print(p)
```



```
## [31] "reservation_status"
                                         "reservation_status_date"
booking_counts <- hotel_bookings %>%
  group_by(hotel, is_canceled) %>%
  summarise(count = n(), .groups = "drop")
print(booking_counts)
## # A tibble: 4 x 3
##
    hotel is_canceled count
##
     <chr>
                       <dbl> <int>
## 1 City Hotel
                            0 46084
## 2 City Hotel
                            1 33079
## 3 Resort Hotel
                            0 28927
## 4 Resort Hotel
                            1 11120
p<-ggplot(booking_counts, aes(x = factor(hotel), y = count, fill = factor(is_canceled))) +</pre>
 geom_bar(stat = "identity", position = "dodge") +
 labs(title = "Bookings Canceled vs Not Canceled",
       x = "Hotel Type",
       y = "Count of Bookings",
       fill = "Booking Status") +
 theme_minimal()
# Print the plot
print(p)
```

Bookings Canceled vs Not Canceled



```
# Save the plot as a PNG file
ggsave("bookings_canceled_vs_not_canceled.png", plot = p, width = 6, height = 4, dpi = 300)
```

```
# 3. What was the percentage of booking for each year?
colnames(hotel_bookings)
  [1] "hotel"
                                          "is_canceled"
##
   [3] "lead time"
                                          "arrival_date_year"
##
  [5] "arrival_date_month"
                                          "arrival_date_week_number"
## [7] "arrival_date_day_of_month"
                                          "stays_in_weekend_nights"
## [9] "stays_in_week_nights"
                                          "adults"
## [11] "children"
                                          "babies"
## [13] "meal"
                                          "country"
                                          "distribution_channel"
## [15] "market_segment"
## [17] "is_repeated_guest"
                                          "previous_cancellations"
## [19] "previous_bookings_not_canceled"
                                         "reserved_room_type"
## [21] "assigned_room_type"
                                          "booking_changes"
## [23] "deposit_type"
                                          "agent"
## [25] "company"
                                          "days_in_waiting_list"
## [27] "customer_type"
                                          "adr"
## [29] "required_car_parking_spaces"
                                          "total_of_special_requests"
## [31] "reservation status"
                                          "reservation_status_date"
#str(hotel_bookings)
booking data<-hotel bookings %>%
  group_by(arrival_date_year) %>%
  summarise(total bookings = n()) %>%
  mutate(percentage = total_bookings / sum(total_bookings) * 100)
print(booking_data)
## # A tibble: 3 x 3
     arrival_date_year total_bookings percentage
##
##
                 <dbl>
                                <int>
                                             18.4
## 1
                  2015
                                21967
## 2
                  2016
                                56623
                                             47.5
## 3
                  2017
                                40620
                                             34.1
p<-ggplot(booking_data, aes(x = "", y = percentage, fill = arrival_date_year)) +</pre>
  geom_bar(stat = "identity", width = 1) +
  coord_polar(theta = "y") +
  labs(title = "Booking Distribution by Arrival Year") +
  theme void() +
  geom_text(aes(label = paste0(round(percentage, 1), "%")), position = position_stack(vjust = 0.5))
# Print the plot
print(p)
```

Booking Distribution by Arrival Year

```
arrival_date_year
                                                                                                                                                              2017.0
                                       34.1%
                                                                                                                                                              2016.5
                                                                                                                                                              2016.0
                                                                                                                                                              2015.5
                                                                                                                                                              2015.0
                                                                               47.5%
# Save the plot as a PNG file
ggsave("percentage_bookings_per_year.png", plot = p, width = 6, height = 4, dpi = 300)
"total-bookings" %in% colnames(hotel_bookings)
## [1] FALSE
#print(hotel_bookings$arrival_date_year)
print(unique(hotel_bookings$arrival_date_year))
## [1] 2015 2016 2017
# 4. Which were the most busiest months for hotels?
#
str(hotel_bookings)
## tibble [119,210 x 32] (S3: tbl_df/tbl/data.frame)
## $ hotel
                                                                                         : chr [1:119210] "Resort Hotel" "Res
## $ is_canceled
                                                                                         : num [1:119210] 0 0 0 0 0 0 0 0 1 1 ...
                                                                                        : num [1:119210] 342 737 7 13 14 14 0 9 85 75 ...
## $ lead_time
## $ arrival_date_year
                                                                                        : num [1:119210] 2015 2015 2015 2015 2015 ...
## $ arrival_date_month
                                                                                        : chr [1:119210] "July" "July" "July" "July" ...
## $ arrival_date_week_number
                                                                                      : num [1:119210] 27 27 27 27 27 27 27 27 27 27 ...
## $ arrival_date_day_of_month
                                                                                        : num [1:119210] 1 1 1 1 1 1 1 1 1 1 ...
## $ stays_in_weekend_nights
                                                                                        : num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
## $ stays_in_week_nights
                                                                                        : num [1:119210] 0 0 1 1 2 2 2 2 3 3 ...
## $ adults
                                                                                        : num [1:119210] 2 2 1 1 2 2 2 2 2 2 ...
## $ children
                                                                                        : int [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
##
         $ babies
                                                                                        : num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
                                                                                         : chr [1:119210] "BB" "BB" "BB" "BB" ...
## $ meal
```

```
## $ country
                                   : chr [1:119210] "PRT" "PRT" "GBR" "GBR" ...
## $ market_segment
                                  : chr [1:119210] "Direct" "Direct" "Direct" "Corporate" ...
## $ distribution_channel
                                  : chr [1:119210] "Direct" "Direct" "Direct" "Corporate" ...
                                  : num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
## $ is_repeated_guest
                                  : num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
## $ previous_cancellations
## $ previous_bookings_not_canceled: num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
## $ reserved_room_type
                                  : chr [1:119210] "C" "C" "A" "A" ...
                                  : chr [1:119210] "C" "C" "C" "A" ...
## $ assigned_room_type
## $ booking_changes
                                  : num [1:119210] 3 4 0 0 0 0 0 0 0 0 ...
                                  : chr [1:119210] "No Deposit" "No Deposit" "No Deposit" "No Deposit
## $ deposit_type
## $ agent
                                   : int [1:119210] NA NA NA 304 240 240 NA 303 240 15 ...
                                   : chr [1:119210] "NULL" "NULL" "NULL" "NULL" ...
## $ company
                                   : num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
## $ days_in_waiting_list
                                  : chr [1:119210] "Transient" "Transient" "Transient" ...
## $ customer_type
## $ adr
                                   : num [1:119210] 0 0 75 75 98 ...
## $ required_car_parking_spaces : num [1:119210] 0 0 0 0 0 0 0 0 0 0 ...
## $ total_of_special_requests
                                  : num [1:119210] 0 0 0 0 1 1 0 1 1 0 ...
                                   : chr [1:119210] "Check-Out" "Check-Out" "Check-Out" "Check-Out" ...
## $ reservation_status
                                   : Date[1:119210], format: "2015-07-01" "2015-07-01" ...
## $ reservation_status_date
colnames(hotel_bookings)
## [1] "hotel"
                                        "is canceled"
## [3] "lead time"
                                        "arrival_date_year"
## [5] "arrival_date_month"
                                        "arrival_date_week_number"
## [7] "arrival_date_day_of_month"
                                        "stays_in_weekend_nights"
## [9] "stays_in_week_nights"
                                        "adults"
## [11] "children"
                                        "babies"
## [13] "meal"
                                        "country"
## [15] "market_segment"
                                        "distribution_channel"
## [17] "is_repeated_guest"
                                        "previous_cancellations"
## [19] "previous_bookings_not_canceled" "reserved_room_type"
## [21] "assigned_room_type"
                                        "booking_changes"
## [23] "deposit_type"
                                        "agent"
## [25] "company"
                                        "days_in_waiting_list"
## [27] "customer_type"
                                        "adr"
## [29] "required_car_parking_spaces"
                                        "total_of_special_requests"
## [31] "reservation_status"
                                        "reservation_status_date"
#str(hotel_bookings)
hotel_bookings %>%
 group_by(arrival_date_month) %>%
 summarise(total_bookings = n()) %>%
 arrange(desc(total_bookings)) # Sort by total bookings in descending order
## # A tibble: 12 x 2
     arrival_date_month total_bookings
##
     <chr>>
                                 <int>
## 1 August
                                 13861
## 2 July
                                 12644
## 3 May
                                 11780
## 4 October
                                 11147
## 5 April
                                 11078
## 6 June
                                 10929
```

```
10500
## 7 September
## 8 March
                                   9768
## 9 February
                                   8052
## 10 November
                                   6771
## 11 December
                                   6759
## 12 January
                                   5921
monthly_bookings <- hotel_bookings %>%
  group_by(arrival_date_month) %>%
  summarise(total_bookings = n()) %>%
  arrange(desc(total_bookings)) # Sort by total bookings in descending order
# Plot the bar chart
p<-ggplot(monthly_bookings, aes(x = reorder(arrival_date_month, -total_bookings), y = total_bookings, f
  geom_bar(stat = "identity") +
  labs(title = "Total Bookings by Arrival Month",
       x = "Month of Arrival",
       y = "Total Bookings") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) # Rotate x-axis labels for readability
# Print the plot
print(p)
```

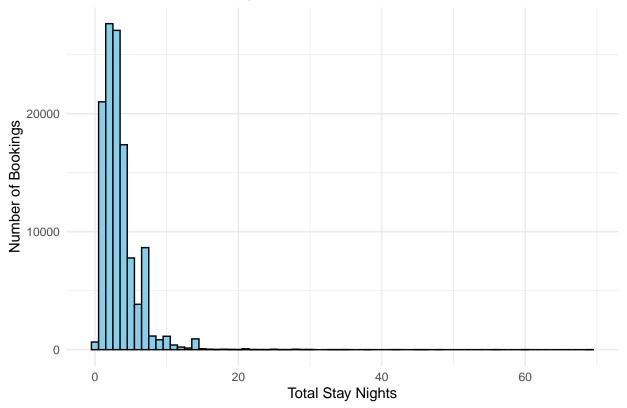
Total Bookings by Arrival Month arrival_date_month April August December 10000 February **Total Bookings** January July June 5000 March May November October September 0 December | November . October February March Ned April mue Month of Arrival

```
# Save the plot as an image
ggsave("busiest_months_hotel_bookings.png", plot = p, width = 6, height = 4, dpi = 300)
```

```
# 5. From which top 3 countries did most guests come from?
# ---
# YOUR GOES BELOW
result <- hotel_bookings %>%
  group_by(country) %>%
  summarise(total_people = sum(adults + children + babies, na.rm = TRUE)) %>%
  arrange(desc(total_people))
# Print the result
print(result)
## # A tibble: 178 x 2
##
     country total_people
##
      <chr>
                     <dbl>
## 1 PRT
                     90036
## 2 GBR
                    24568
## 3 FRA
                    21579
## 4 ESP
                    18153
## 5 DEU
                    14198
## 6 ITA
                    7856
## 7 IRL
                     6909
## 8 BEL
                     4911
## 9 BRA
                     4867
## 10 USA
                     4318
## # i 168 more rows
'total_stay_nights' %in% colnames(hotel_bookings)
## [1] FALSE
# 6.a) How long do most people stay in hotels?}
# b) By city and resort? Separate the data by hotel
# ---
#
# Create a new column for total stay duration (nights)
hotel_bookings <- hotel_bookings %>%
  mutate(total_stay_nights = stays_in_week_nights + stays_in_weekend_nights)
# Summarize the most common stay durations
stay_distribution <- hotel_bookings %>%
  group_by(total_stay_nights) %>%
  summarise(count = n()) %>%
  arrange(desc(count))
# Print the most common stay duration
print(stay_distribution)
## # A tibble: 42 x 2
     total_stay_nights count
                <dbl> <int>
##
## 1
                     2 27632
## 2
                     3 27064
```

```
1 21005
##
##
   4
                      4 17373
                      7 8648
##
                      5 7771
##
   6
##
                      6 3846
##
  8
                      8 1155
##
                     10 1135
## 10
                         913
                     14
## # i 32 more rows
# Plot a histogram of stay durations
p<-ggplot(hotel_bookings, aes(x = total_stay_nights)) +</pre>
  geom_histogram(binwidth = 1, fill = "skyblue", color = "black") +
  labs(title = "Distribution of Hotel Stay Durations",
       x = "Total Stay Nights",
       y = "Number of Bookings") +
  theme_minimal()
# Save the plot to a file
ggsave("hotel_stay_distribution_plot.png", plot = p, width = 8, height = 6)
# Optionally, print the plot to the R console as well
print(p)
```

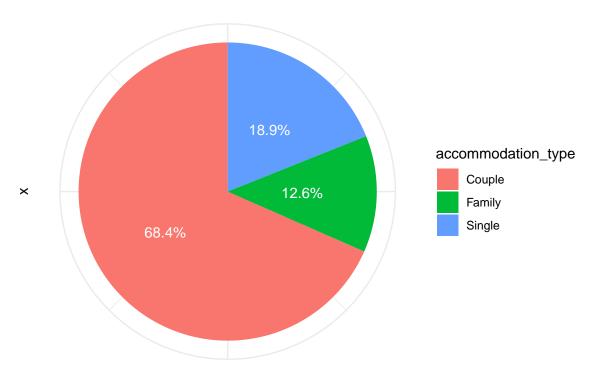
Distribution of Hotel Stay Durations



```
###Question b
hotel_bookings %>%
mutate(total_stay_nights = stays_in_week_nights + stays_in_weekend_nights) %>%
```

```
group_by(country, hotel) %>%
  summarise(avg_stay_nights = mean(total_stay_nights, na.rm = TRUE)) %>%
  arrange(desc(avg_stay_nights))
## `summarise()` has grouped output by 'country'. You can override using the
## `.groups` argument.
## # A tibble: 293 x 3
## # Groups: country [178]
      country hotel
##
                          avg_stay_nights
      <chr>
             <chr>
##
                                     <dbl>
## 1 FRO
             City Hotel
                                    12
## 2 SEN
             Resort Hotel
                                    10
## 3 AZE
                                     9
             Resort Hotel
          Resort Hotel
## 4 TGO
                                     9
## 5 SEN
          City Hotel
                                     8.7
          City Hotel
## 6 AGO
                                     8.48
## 7 MKD
             Resort Hotel
                                     8
## 8 CPV
             City Hotel
                                     7.16
## 9 GNB
             City Hotel
                                     7.11
             Resort Hotel
## 10 ARM
## # i 283 more rows
# 7. Which was the most booked accommodation type (Single, Couple, Family)?
# ---
#
#colnames(hotel_bookings)
#str(hotel bookings)
accommodation data <- hotel bookings %>%
mutate(accommodation_type = case_when(
    adults == 1 & children == 0 & babies == 0 ~ "Single",
   adults == 2 & children == 0 & babies == 0 ~ "Couple",
   adults >= 2 | children > 0 | babies > 0 ~ "Family",
   TRUE ~ "Other"
  )) %>%
  group_by(accommodation_type) %>%
  summarise(total_bookings = n()) %>%
  arrange(desc(total_bookings))%>%
  mutate(Percentage_total_bookings=(total_bookings/sum(total_bookings))*100)
print(accommodation_data)
## # A tibble: 3 x 3
    accommodation_type total_bookings Percentage_total_bookings
##
##
     <chr>>
                                 <int>
                                                           <dbl>
## 1 Couple
                                                            68.4
                                 81560
## 2 Single
                                 22577
                                                            18.9
## 3 Family
                                 15073
                                                            12.6
# Create the pie chart with percentages
p<-ggplot(accommodation_data, aes(x = "", y = Percentage_total_bookings, fill = accommodation_type)) +
  geom_bar(stat = "identity", width = 1) +
  coord_polar(theta = "y") + # Convert to pie chart
  geom_text(aes(label = paste0(round(Percentage_total_bookings, 1), "%")),
```

Distribution of Accommodation Types



Percentage_total_bookings

5.b) Recommendations

From the above analysis, below are our recommendations:

Accommodation type and bookings: Couple bookings make up the majority, accounting for 68.42% of total bookings. Single bookings represent 18.94%, and family bookings account for 12.64%. This suggests that most bookings are for couples.

Hotel type and average stay: Resort hotels tend to have a slightly lower average stay (around 9 nights) compared to city hotels, which have a higher average stay (around 12 nights). Several countries (e.g., FRO, SEN, AZE) primarily have resort hotels with an average stay of 9 nights, while others (e.g., CPV, GNB) lean toward city hotels with average stays of 7 nights or lower.

Booking frequency by country: Portugal (PRT) has the highest number of bookings (90,036), followed by Great Britain (GBR) (24,568), and France (FRA) (21,579). USA and Brazil have lower booking counts (4,318 and 4,867, respectively), suggesting fewer bookings from these countries.

Bookings by month: August has the highest number of bookings (13,861), followed by July (12,644) and May (11,780). The months of March and November see significantly fewer bookings, with 9,768 and 6,771, respectively.

Cancellations: The data shows cancellations are more frequent for city hotels (with 33,079 cancellations compared to 46,084 non-cancellations) compared to resort hotels. This indicates that city hotels might experience a higher cancellation rate.

Bookings over the years: The number of bookings was highest in 2016 (56,623 bookings), followed by 2017 (40,620 bookings). 2015 had the lowest number of bookings (21,967), which could indicate an increase in bookings over time.

These trends suggest that couples prefer city hotels for longer stays, while families and singles lean more towards resort hotels. There are also clear seasonal peaks, with summer months (May-August) being particularly busy for bookings.

Based on the analysis of **cancellation rates** and **booking trends** by month, here are some recommendations for hotels:

Target marketing towards couples: Since couple bookings make up the majority of total bookings (68.42%), marketing campaigns could focus more on this group, offering tailored packages or promotions for couples. This could include offering longer stays at city hotels, which have higher average stays.

Focus on resort hotels for family and single travelers: Given that families and singles make up a smaller percentage of bookings, offering special family packages or single traveler discounts could help boost bookings in resort hotels, which tend to have slightly shorter stays. Emphasizing the leisure and relaxation aspects of resort hotels may attract these groups.

Seasonal promotions for peak months: With the highest number of bookings occurring during the summer months (May-August), it would be beneficial to launch special seasonal promotions or early-bird offers during these months to capitalize on the high demand.

Improve cancellation policies for city hotels: Since city hotels experience a higher rate of cancellations, offering more flexible cancellation policies or incentives for non-cancelled bookings (e.g., discounts on future stays) could help reduce cancellations and increase bookings.

Target specific countries with lower bookings: Countries like the USA and Brazil have fewer bookings. Special promotions or campaigns targeted toward these regions could help increase the number of bookings from these countries. This might include region-specific offers, localized marketing, or partnerships with travel agencies in those countries.

Encourage longer stays in resort hotels: Since resort hotels have slightly lower average stays, offering incentives for guests to stay longer, such as discounted rates for extended stays, could help increase the average stay duration and revenue for these properties.

6. Challenging your Solution

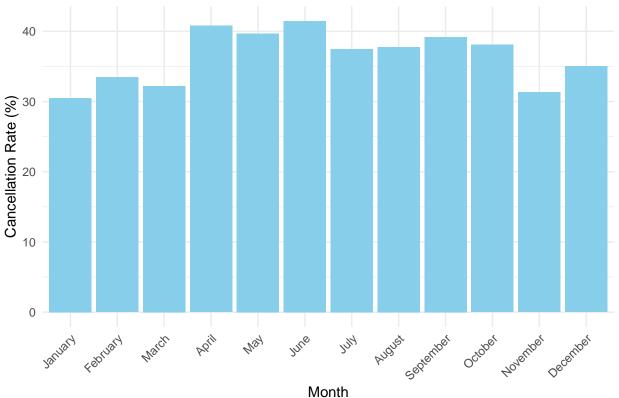
In this step, we review our solution and implement approaches that could potentially provide a better outcome. In our case, we could propose the following question that wasn't answered in our solution because it couldn't have greatly contributed to our recommendation.

```
# When should hotels provide special offers?
# ---
# YOUR GOES BELOW
#
```

```
colnames(hotel_bookings)
   [1] "hotel"
                                          "is canceled"
##
  [3] "lead time"
                                          "arrival_date_year"
## [5] "arrival_date_month"
                                          "arrival_date_week_number"
## [7] "arrival_date_day_of_month"
                                          "stays_in_weekend_nights"
                                          "adults"
## [9] "stays_in_week_nights"
## [11] "children"
                                          "babies"
## [13] "meal"
                                          "country"
## [15] "market_segment"
                                          "distribution_channel"
## [17] "is_repeated_guest"
                                          "previous_cancellations"
## [19] "previous_bookings_not_canceled"
                                         "reserved_room_type"
## [21] "assigned_room_type"
                                          "booking_changes"
## [23] "deposit_type"
                                          "agent"
## [25] "company"
                                          "days_in_waiting_list"
## [27] "customer_type"
                                          "adr"
## [29] "required_car_parking_spaces"
                                          "total_of_special_requests"
## [31] "reservation status"
                                          "reservation_status_date"
## [33] "total_stay_nights"
special_offer <- hotel_bookings %>%
  #mutate(total_stay_nights = stays_in_week_nights + stays_in_weekend_nights) %>%
  group_by(arrival_date_month) %>%
  summarise(
   total bookings = n(),
   total_canceled = sum(is_canceled == 1),
   total_not_canceled = sum(is_canceled == 0),
    #total_stay_nights = sum(total_stay_nights, na.rm = TRUE)
  arrange(desc(total_bookings))
print(special_offer)
## # A tibble: 12 x 4
##
      arrival_date_month total_bookings total_canceled total_not_canceled
                                  <int>
##
      <chr>>
                                                  <int>
                                  13861
                                                                      8624
## 1 August
                                                   5237
## 2 July
                                  12644
                                                   4737
                                                                      7907
## 3 May
                                                                      7103
                                  11780
                                                   4677
## 4 October
                                  11147
                                                   4246
                                                                      6901
## 5 April
                                  11078
                                                   4518
                                                                      6560
## 6 June
                                  10929
                                                   4534
                                                                      6395
## 7 September
                                  10500
                                                   4115
                                                                      6385
## 8 March
                                   9768
                                                   3148
                                                                      6620
## 9 February
                                    8052
                                                   2693
                                                                      5359
## 10 November
                                    6771
                                                   2120
                                                                      4651
## 11 December
                                    6759
                                                   2368
                                                                      4391
## 12 January
                                    5921
                                                   1806
                                                                      4115
# Calculate cancellation rate per month
offer <- special_offer %>%
  mutate(cancellation_rate = total_canceled / total_bookings * 100) %>%
  mutate(arrival_date_month = factor(arrival_date_month, levels = month.name)) # order months
```

```
print(offer)
## # A tibble: 12 x 5
##
      arrival_date_month total_bookings total_canceled total_not_canceled
##
      <fct>
                                   <int>
                                                   <int>
                                                                       <int>
   1 August
##
                                   13861
                                                    5237
                                                                        8624
##
    2 July
                                   12644
                                                    4737
                                                                        7907
                                                    4677
                                                                        7103
##
   3 May
                                   11780
##
  4 October
                                   11147
                                                    4246
                                                                        6901
##
   5 April
                                   11078
                                                    4518
                                                                        6560
##
   6 June
                                   10929
                                                    4534
                                                                        6395
##
   7 September
                                   10500
                                                    4115
                                                                        6385
   8 March
                                    9768
                                                    3148
                                                                        6620
##
   9 February
                                    8052
                                                    2693
                                                                        5359
## 10 November
                                    6771
                                                    2120
                                                                        4651
## 11 December
                                    6759
                                                    2368
                                                                        4391
## 12 January
                                    5921
                                                    1806
                                                                        4115
## # i 1 more variable: cancellation_rate <dbl>
# Plot the cancellation rate against the month
ggplot(offer, aes(x = arrival_date_month, y = cancellation_rate)) +
  geom_bar(stat = "identity", fill = "skyblue") +
  labs(title = "Cancellation Rate per Month",
       x = "Month",
       y = "Cancellation Rate (%)") +
  theme minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) # Rotate x-axis labels for clarity
```





Our observations:

How does this observation tie to our solution?

Higher cancellation rates may signal suitable periods for special offers like in April and June.

Months with fewer bookings may indicate lower demand, and special offers can be used to attract more customers. For instance, as November and February have fewer bookings, hotels can offer discounts or promotions to boost demand.

7. Follow up questions

During this step, you rethink and propose other ways that you can improve your solution.

a). Did we have the right data? b). Do we need other data to answer our question? c). Did we have the right question?

```
colnames(hotel bookings)
```

```
[1] "hotel"
                                          "is canceled"
                                          "arrival_date_year"
##
    [3] "lead time"
##
    [5] "arrival_date_month"
                                          "arrival date week number"
    [7] "arrival_date_day_of_month"
                                          "stays_in_weekend_nights"
##
   [9] "stays in week nights"
                                          "adults"
##
        "children"
                                          "babies"
## [11]
## [13]
        "meal"
                                          "country"
## [15] "market_segment"
                                          "distribution_channel"
## [17] "is_repeated_guest"
                                          "previous_cancellations"
  [19] "previous_bookings_not_canceled"
                                          "reserved_room_type"
  [21] "assigned_room_type"
                                          "booking_changes"
## [23] "deposit type"
                                          "agent"
## [25] "company"
                                          "days_in_waiting_list"
   [27] "customer_type"
                                          "adr"
  [29] "required_car_parking_spaces"
                                          "total_of_special_requests"
## [31] "reservation status"
                                          "reservation_status_date"
## [33] "total stay nights"
```

The provided data seems to cover essential aspects such as accommodation type, booking, duration in the hotels country etc. However, there could be gaps in data that might provide more insights, such as customer satisfaction metrics (reviews or feedback). These additional data points could help refine the recommendations, especially for targeting specific customer groups or improving the guest experience.

Do we need other data to answer our question?

Yes, additional data would enhance the solution. For instance:

Booking source or channel: Knowing where bookings originate from (e.g., direct website, third-party platforms) could help refine marketing strategies. Customer feedback and satisfaction: Data on guest satisfaction (ratings, reviews) would allow for better understanding of preferences and areas for improvement. Booking trends over longer periods: Data from multiple years or months could help identify long-term trends rather than just focusing on short-term fluctuations.

Did we have the right question?

Generally, yes, but the data is insufficient to provide clear guidelines on how to optimize strategies for customer retention and loyalty. We need a deeper understanding of customer behavior and preferences to effectively develop strategies that foster customer loyalty and encourage repeat bookings. For example:

Why are bookings higher during certain months or in certain countries? Understanding the factors behind seasonality and country-specific preferences could lead to more targeted interventions but this requires also more data as we mentioned above mainly about the customers satisfaction and reviews what not even their salary, the payment method an so on.

What factors influence cancellations, and how can we mitigate them? A deeper exploration of what drives cancellations (e.g., price sensitivity, competition, customer dissatisfaction) could provide clearer strategies for reducing them.

How can we improve the guest experience to encourage repeat bookings? Focusing on customer retention (activities during stay...) and loyalty strategies could add a dimension to the recommendations