

# Assignment Week 5-Conrardy

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## Assignment Week #5

```
knitr::include_graphics("assignment_4.png")
```

## Assignment – Tidying and Transforming Data

		Los Angeles	Phoenix	San Diego	San Francisco	Seattle
ALASKA	on time	497	221	212	503	1,841
	delayed	62	12	20	102	305
AM WEST	on time	694	4,840	383	320	201
	delayed	117	415	65	129	61

Source: *Numbersense*, Kaiser Fung, McGraw Hill, 2013

The chart above describes arrival delays for two airlines across five destinations. Your task is to:

- (1) Create a .CSV file (or optionally, a MySQL database!) that includes all of the information above. You're encouraged to use a "wide" structure similar to how the information appears above, so that you can practice tidying and transformations as described below.
- (2) Read the information from your .CSV file into R, and use *tidyr* and *dplyr* as needed to tidy and transform your data.
- (3) Perform analysis to compare the arrival delays for the two airlines.
- (4) Your code should be in an R Markdown file, posted to *rpubs.com*, and should include narrative descriptions of your data cleanup work, analysis, and conclusions. Please include in your homework submission:
  - The URL to the .Rmd file in your GitHub repository. and
  - The URL for your *rpubs.com* web page.

## Import Untidy Data from MySQL Database

```
flight_db <- dbConnect(MySQL(), user = "aconrardy", password = "DocGrad2023*", dbname = 'assignment_week1')
flight_data <- dbReadTable(flight_db, "flight_data")
flight_data
```

```
##   ident_city arrival_city alaska_total alaska_ontime alaska_delayed
## 1         1   Los Angeles         559          497             62
## 2         2     Phoenix         233          221             12
## 3         3   San Diego         232          212             20
## 4         4 San Francisco         605          503            102
## 5         5     Seattle        2146         1841            305
##   amwest_total amwest_ontime amwest_delayed
## 1          811          694           117
## 2         5255         4840           415
## 3          448          383            65
## 4          449          320           129
## 5          262          201            61
```

## Tidying and Transforming the Data

In this section we are going to clean up the data so that it is “tidy” and able to be analyzed efficiently. The above data was structured to have eight (8) columns containing various information for the different airlines. This can be reduced to four (4) columns to identify carrier, airport, status (on-time/delayed) and the number of flights. The totals for the airline could be ignored because they can be calculated simply by adding the number of on time and delayed flights. The “ident\_city” column can also be ignored for this assignment, but if it is needed to link to another dataset the ident\_city column may become necessary. We will use the Tidyr package and pivot each carrier column, and then bind the rows together in a long format. We are then reducing the number of initial variables from eight (8) to four (4), but increasing the number of rows from five (5) to twenty (20).

```
# We are going to split the column label to form the "carrier" and "status" columns, then place the values into a count column
flight_data1 <- flight_data |> pivot_longer(
  cols = (alaska_ontime),
  names_to = c("carrier", "status"),
  names_sep = "_",
  values_to = "count")
flight_data1 <- flight_data1 |> select(arrival_city, carrier, status, count)

# We are going to do the same for each of the other columns in the data frame, establishing a total count column
flight_data2 <- flight_data |> pivot_longer(
  cols = (alaska_delayed),
  names_to = c("carrier", "status"),
  names_sep = "_",
  values_to = "count")
flight_data2 <- flight_data2 |> select(arrival_city, carrier, status, count)

flight_data3 <- flight_data |> pivot_longer(
  cols = (amwest_ontime),
  names_to = c("carrier", "status"),
  names_sep = "_",
```

```

values_to = "count")
flight_data3 <- flight_data3 |> select(arrival_city, carrier, status, count)

flight_data4 <- flight_data |> pivot_longer(
  cols = (amwest_delayed),
  names_to = c("carrier", "status"),
  names_sep = "_",
  values_to = "count")
flight_data4 <- flight_data4 |> select(arrival_city, carrier, status, count)

# We are then going to row bind the four (4) new data frames to establish our new data frame for analysis
tidy_data <- rbind(flight_data1,flight_data2,flight_data3,flight_data4)
tidy_data

```

```

## # A tibble: 20 x 4
##   arrival_city carrier status count
##   <chr>         <chr>   <chr>  <int>
## 1 Los Angeles  alaska  ontime   497
## 2 Phoenix      alaska  ontime   221
## 3 San Diego    alaska  ontime   212
## 4 San Francisco alaska  ontime   503
## 5 Seattle      alaska  ontime  1841
## 6 Los Angeles  alaska  delayed    62
## 7 Phoenix      alaska  delayed    12
## 8 San Diego    alaska  delayed    20
## 9 San Francisco alaska  delayed   102
## 10 Seattle     alaska  delayed   305
## 11 Los Angeles  amwest  ontime   694
## 12 Phoenix      amwest  ontime  4840
## 13 San Diego    amwest  ontime   383
## 14 San Francisco amwest  ontime   320
## 15 Seattle      amwest  ontime   201
## 16 Los Angeles  amwest  delayed   117
## 17 Phoenix      amwest  delayed   415
## 18 San Diego    amwest  delayed    65
## 19 San Francisco amwest  delayed   129
## 20 Seattle     amwest  delayed    61

```

## Data Analysis

We can now start our analysis of the data we tidied and transformed in the previous section. We are also going to do some additional changes so the resulting plots look appropriate. In this section, we are going to:

- 1) rename a column to avoid confusion between a variable name and an R function.
- 2) calculate the total number of flights coming into each arrival city from both carriers.
- 3) calculate the percentage of on-time and delayed flights for each carrier as it relates to the overall flights coming into the arrival city.
- 4) calculate the on-time and delayed flight percentage for each carrier.
- 5) Re-label the carrier names so it looks better on our graphic display.

```

# We are going to rename a column because we are having difficulties differentiating the name "count" f
tidy_data <- tidy_data |> rename(num_flight = count)

# We are going to establish new label names for the carriers.
new_labels <- c("alaska" = "Alaska Airlines", "amwest" = "Am West Airlines")

# We are going to identify the total number of flights coming into each arrival city
total_counts <- aggregate(num_flight ~ arrival_city, tidy_data, sum)

# We are going to identify the number of flights coming into an arrival city and total their status for
carrier_total_counts <- tidy_data |> group_by(arrival_city, carrier) |> summarize(carrier_total=sum(num

# We are then going to merge the total number of flights back into the original data frame into a new c
tidy_data1 <- merge(tidy_data, total_counts, by = "arrival_city", suffixes = c("", "_total"))

# We are then going to merge the status totals of flights back into the original data frame into a new
tidy_data2 <- merge(tidy_data, carrier_total_counts, by = c("arrival_city", "carrier"), suffixes = c("

# We are then going to create a new column calculating the percentage of the total flights into the arr
# This could have also been done using mutate.
# tidy_data1 <- tidy_data1 |> mutate(percentage_total = (num_flight / num_flight_total) * 100)
tidy_data1$percentage_total <- (tidy_data1$num_flight / tidy_data1$num_flight_total)*100

# We are then going to create a new column calculating the carrier percentage total of delayed and on-t
tidy_data2 <- tidy_data2 |> mutate(carrier_percentage_total = (num_flight / carrier_total) * 100)

```

In this section we are going to present our first graphic, a column plot indicating the total number of flights coming into five arrival cities. We can clearly see that Phoenix receives the highest volume of flights from the two carriers (Alaska and Am West), followed by Seattle. We can also see that San Diego receives the least number of flights.

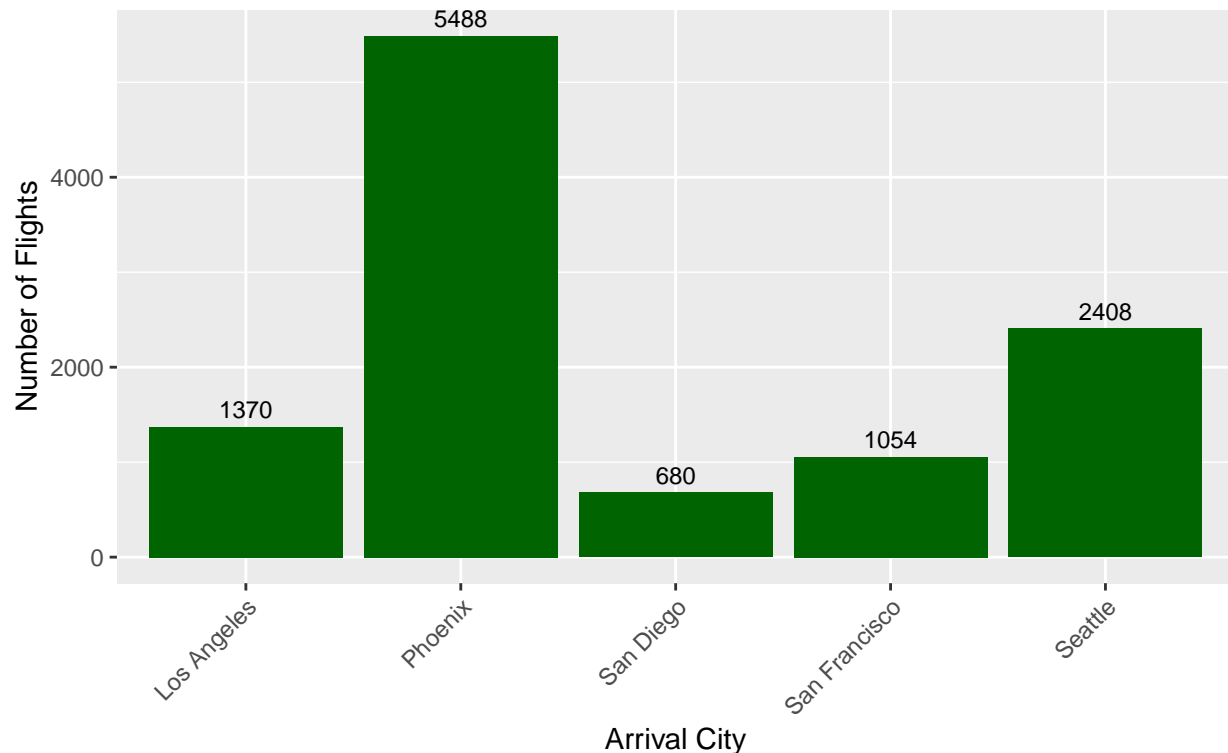
```

ggplot(total_counts, aes(x = arrival_city, y = num_flight)) +
  geom_col(fill = "dark green") +
  labs(x = "Arrival City",
       y = "Number of Flights",
       title = "Total Number of Flights by Arrival City",
       subtitle = "Figure #1") +
  geom_text(aes(label=paste0(num_flight)),
            position = position_dodge(width = 0.9),
            vjust = -0.5,
            size = 3) +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))

```

## Total Number of Flights by Arrival City

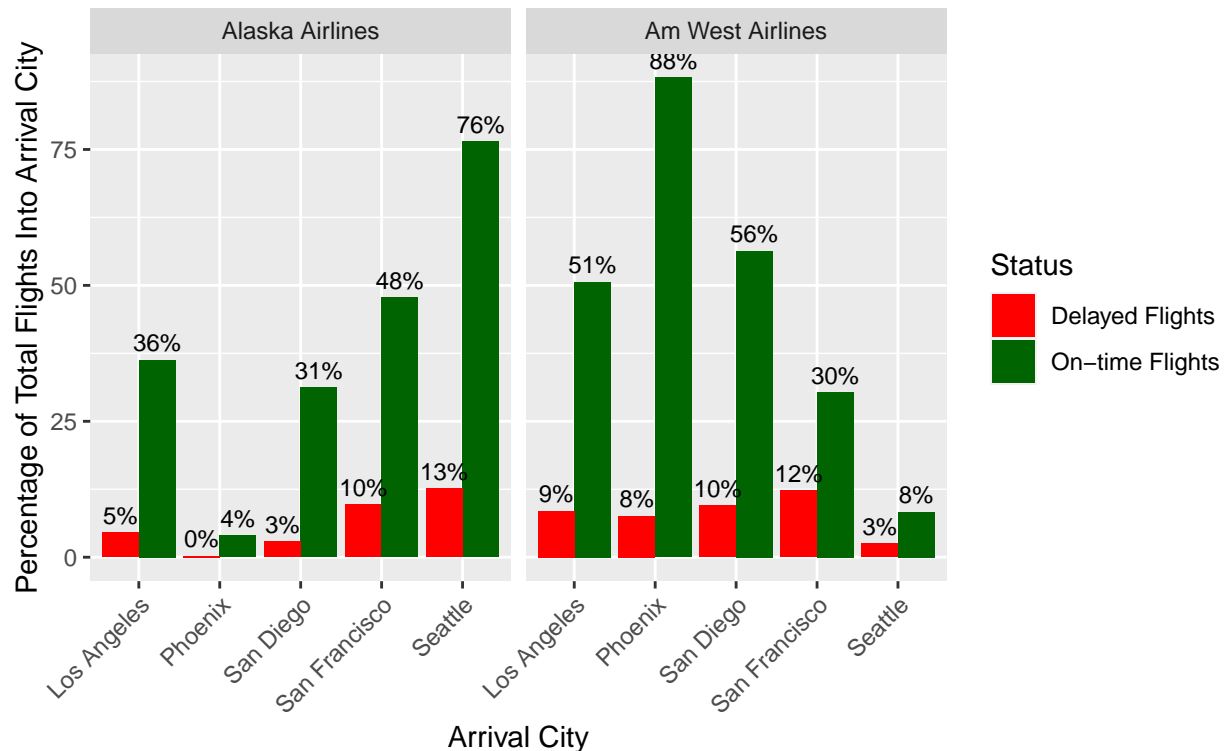
Figure #1



We can continue our analysis by differentiating the carriers and their performance in each one of these arrival cities to see their individual impact on flight delays. We will plot the percentage of the total number of flights coming into each city for both on-time and delayed flights for each carrier. Using `facet_wrap` makes this option much easier, and we will place the new labels on top of each panel.

```
ggplot(tidy_data1, aes(x = arrival_city, y = percentage_total, fill = status)) +
  geom_col(position = "dodge") +
  facet_wrap(~carrier, labeller = labeller(carrier = new_labels)) +
  geom_text(aes(label=paste0(round(percentage_total), "%"),
    position = position_dodge(width = 0.9),
    vjust = -0.5,
    size = 3) +
  labs(x = "Arrival City",
    y = "Percentage of Total Flights Into Arrival City",
    title = "On-time/Delayed Performance",
    subtitle = "Figure #2-Alaska and Am West Airlines",
    fill = "Status") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) +
  scale_fill_manual(values = c("delayed" = "red", "ontime" = "dark green"),
    labels = c("Delayed Flights", "On-time Flights"))
```

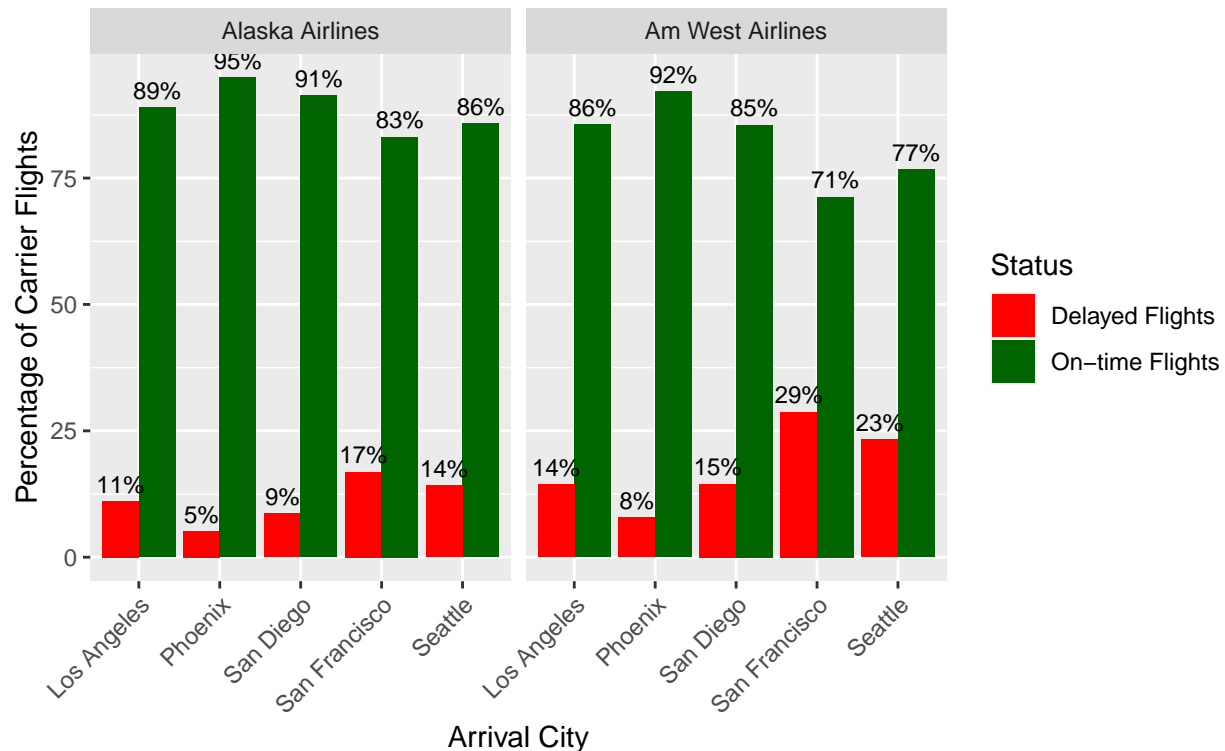
On-time/Delayed Performance  
Figure #2-Alaska and Am West Airlines



We are going to create one more graphic to further investigate on time performance. We can compare the percentage of the individual carriers flights into a specific arrival city, rather than the overall number of flights, to see if a particular carrier has a “problem” area. The Official Airline Guide (OAG) publishes available data for the airline industry and can be accessed via <https://www.oag.com/>. It has been suggested that an on time performance of 90% or better is considered “exceptional”, while 80% or above is considered “pretty good”. For our purposes, we will consider anything less than 80% on-time performance, or greater than 20% delayed arrival, to be insufficient.

```
ggplot(tidy_data2, aes(x = arrival_city, y = carrier_percentage_total, fill = status)) +
  geom_col(position = "dodge") +
  facet_wrap(~carrier, labeller = labeller(carrier = new_labels)) +
  geom_text(aes(label=paste0(round(carrier_percentage_total), "%"),
    position = position_dodge(width = 0.9),
    vjust = -0.5,
    size = 3) +
  labs(x = "Arrival City",
    y = "Percentage of Carrier Flights",
    title = "On-time/Delayed Performance",
    subtitle = "Figure #3-Alaska and Am West Airlines",
    fill = "Status") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) +
  scale_fill_manual(values = c("delayed" = "red", "ontime" = "dark green"),
    labels = c("Delayed Flights", "On-time Flights"))
```

On-time/Delayed Performance  
Figure #3–Alaska and Am West Airlines



### Findings and Conclusions

We can immediately see some interesting findings from our analysis and graphic representations. While Phoenix is the arrival city with the most flights (Figure #1), Am West is the carrier that accounts for 96% of the flights coming into that city and accounts for the largest percentage of delayed flights (Figure #2-8% vs <1%). However, we can also see by the graphic output that the percentage of delayed flights into Phoenix by each carrier indicates that Am West has a larger percentage of delayed flights as compared to Alaska (Figure #3-8% vs 5%). Alaska Airlines is the carrier that accounts for 89% of the flights going into Seattle, with a much larger percentage of the overall delayed flights than Am West (13% vs. 3%).

The point of concern may be the indication that Am West has arrival delay problems into both Seattle and San Francisco, delayed flights 23% and 29% respectively (Figure #3), though they account for a much smaller percentage of the overall flights into those cities, 8% and 30% respectively (Figure #2). Am West may want to focus resources to improve on-time performance toward “pretty good”.