Regression and Other Stories: Ch 2

Data and measurement

This linear models course focuses on:

- fitting lines (functional relationships),
- making comparisons and predictions, and
- assessing uncertainties in inferences.

A major component of these steps requires understanding and assessing assumptions. However, before talking about that and more, it is necessary to understand the data. There is a common adage, *Garbage in, Garbage Out* that succiently summarizes the problem of a poor dataset.

Validity and Reliability

As you start working with datasets, I'd encourage you to think about where the data came from *not the spreadsheet, but rather the actual data collection process.*

Measurement Consider the data collection process for vegetation cover class data.

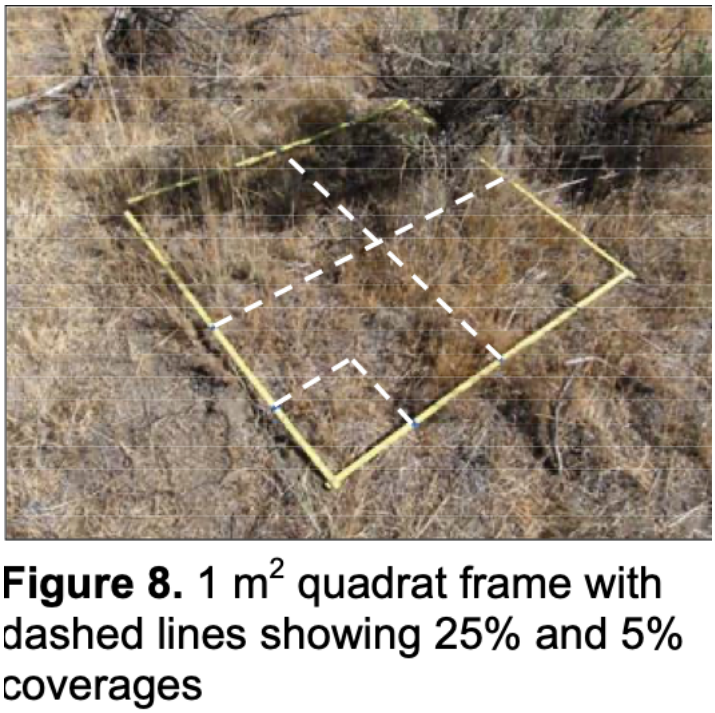


Figure 1: Cover class data, source: Upper Columbia Basin Network Sagebrush Steppe Vegetation Monitoring Protocol by Yeo, Rodhouse, Dicus, Irvine, Garrett

The data is reported as ordinal response, with classes like

- *0 = 0 %*
- *1 = 0 - 5%*
- *2 = 5 - 20%*
- *3 = 20 - 40%*

When designing studies and collecting data, precision of the measurements is an important consideration *that is informed by your research question.*

Measurement can be challenging in many situations, a few include:

- *things that are difficult to count*
- *things that cannot be counted (beliefs)*

Taking multiple measurements can be advantageous.

- *multiple survey questions*
- *occupancy models*

Validity The **validity** of measurement is the degree to which it represents what you are trying to measure. *This is not a binary variable, but can be thought of along a spectrum.*

ROS defines validity as *giving the right answers on average across a wide range of scenarios.*

Reliability The **reliability** of a measurement is the degree to which it is *precise and stable. In other words, repeated reliable measurements should give similar results.*

Sample Selection A fundamental goal in statistics is to extend inferences from a sample to a study population.

This extension requires understanding how the data was selected. In particular, *selection bias and non-response can be problematic*

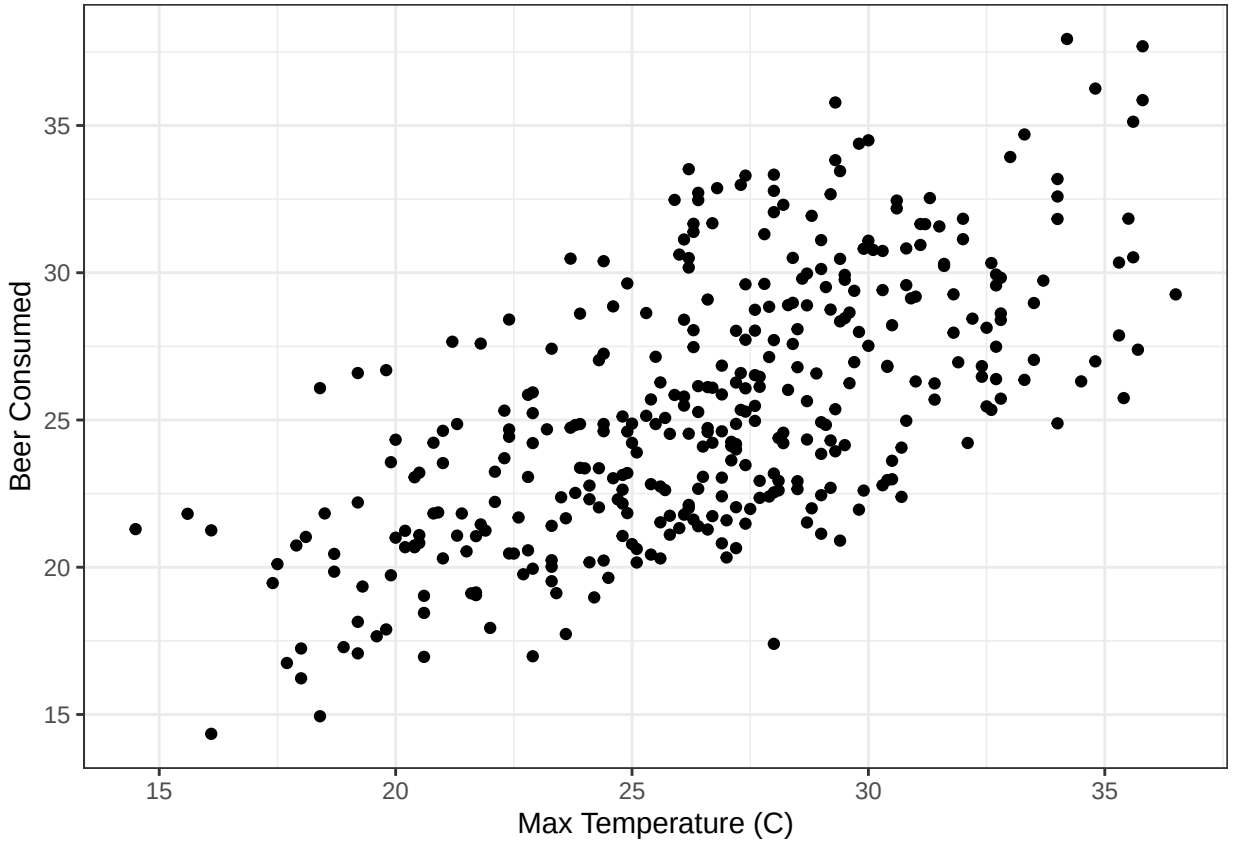
Data Visualiztion

ROS suggests that all graphs are comparisons.

```
beer <- read_csv('http://math.montana.edu/ahoegh/Data/Brazil_cerveja.csv')
```

```
## Parsed with column specification:
## cols(
##   consumed = col_double(),
##   precip = col_double(),
##   max_tmp = col_double(),
##   weekend = col_double()
## )
```

Q: What kind of graph is this and what is the comparison?



Graphical displays of data enable viewing several pieces of data. Specifically, a different variable can be associated with all of the following elements.

- *x position*
- *y position*
- *symbol color*
- *symbol type*
- *symbol size*

Furthermore, faceting can allow more figures to be shown.

Graphical principles

- *When reporting data, in general figures are better than tables.*

- *when using tables, avoid unnecessary precision*

- *show the data*

- *informative captions/labels/titles*

- *Combining graphics into panels can help elucidate relationships and save space in reports.*

- *assume the reader might just look at the graphics, they should be able to "stand alone"*

```
fig1 <- beer %>% mutate(weekend_fact = factor(weekend, labels = c('weekday','weekend')))  %>%
  ggplot(aes(y = consumed, x = max_tmp, color = weekend_fact, shape = weekend_fact)) +
  geom_point() + theme_bw() + ylab('Beer Consumed (l)') +
  xlab('Max Temperature (C)') + labs(color = 'Day of Week') +
  geom_smooth(method = 'loess', formula = 'y~x') +  guides(shape = FALSE) +
  ggtitle('Sample of Beer Consumption in Sao Paolo, Brazil')

fig2 <- beer %>% mutate(weekend_fact = factor(weekend, labels = c('weekday','weekend'))) %>%
  ggplot(aes(y = consumed, x = weekend_fact, color = weekend_fact, shape = weekend_fact)) +
  geom_violin() + geom_jitter()  + ylab('Beer Consumed (l)') +
  ylim(0,NA) + theme_bw() + theme(legend.position = 'none') + xlab('Day of Week') +
  labs(caption = 'source:https://www.kaggle.com/dongeorge/beer-consumption-sao-paulo')

grid.arrange(fig1, fig2)
```

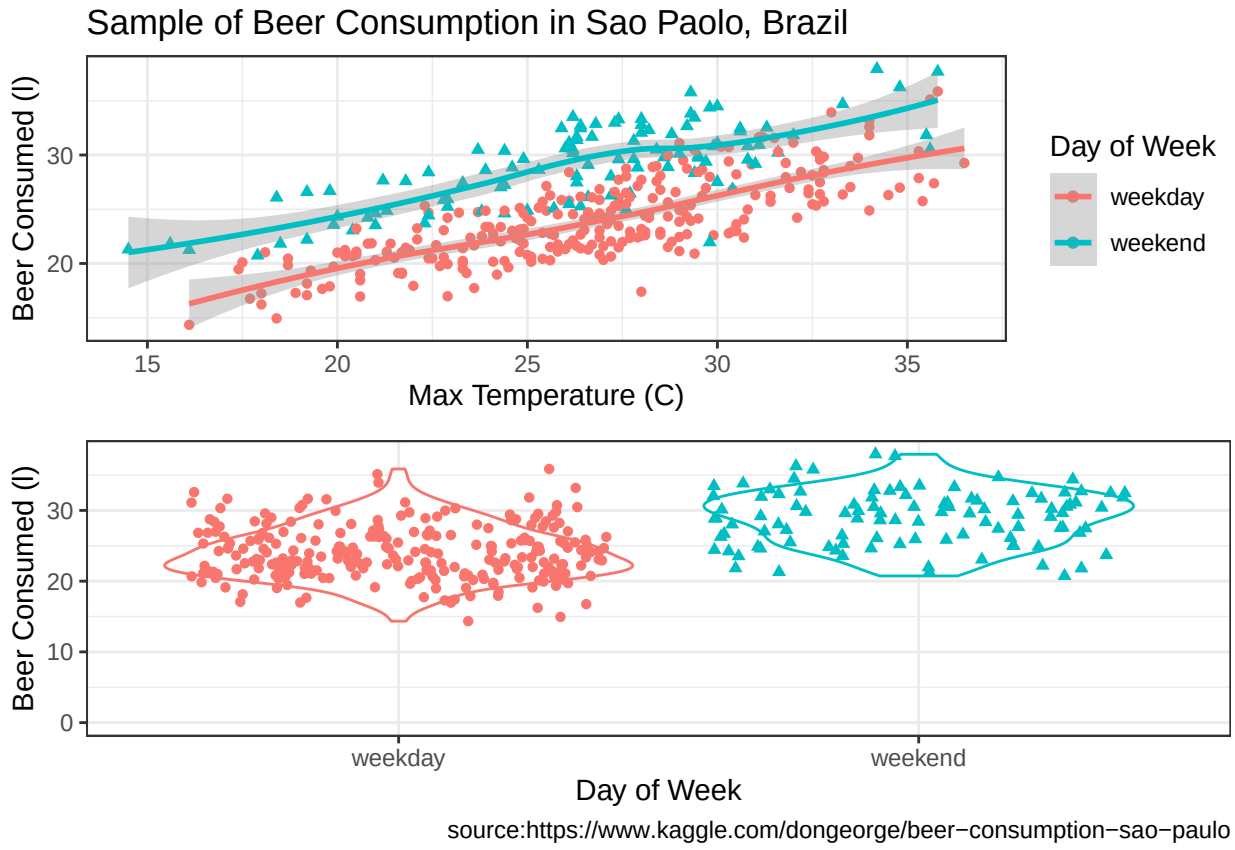


Figure 2: Exploration of beer consumption by temperature and weekend / weekday. The figures suggest higher temperatures and weekends are associated with predicted increases in beer consumption.

There are three main types of graphics:

1. Exploratory Data Analysis: *The goal is to see things you did not expect or know to look for. Generally these are not very polished (for yourself).*

2. Graphs of fitted models and inferences: *Generally involve overlaying data to understand model fit*

3. Graphs of Final Results: *a communication tool. Present results clearly on the page, including the use of captions.*