Almond Yield as a Function

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Import and subset climate data

```
almond_climate_original <- read.table(here("data", "clim.txt")) %>%
  clean_names()

almond_climate <- almond_climate_original %>%
  mutate(date = as_date(d)) %>%
  mutate(year = year(date)) %>%
  mutate(month = month(date))

# temp in february
almond_temp <- almond_climate %>%
  filter(month == 2) %>%
  group_by(year) %>%
  summarize(mean_min = mean(tmin_c)) %>%
  select(year, mean_min)

# precip in january
almond_precip <- almond_climate %>%
  filter(month == 1) %>%
  group_by(year) %>%
  summarize(mean_p = mean(precip), sum_p = sum(precip)) %>%
  select(year, sum_p)
```

Import and execute function to estimate almond yield anomalies

```
source(here("R", "almond_yield.R"))

yield <- almond_yield(year = almond_temp$year, p = almond_precip$sum_p, Tn = almond_temp$mean_min)
```

Summary figures

```
#Use graph to show the trend of how almond yield changes across years
plot_yield <- ggplot(data = yield, aes(x = year, y = almond_yield)) +
  geom_line() +
  labs(title = "Estimated Almond Yields Anomaly", x = "Year", y = "Almond Yield \nAnomaly \n(tons/acre)")

plot_temperature <- ggplot(data = almond_temp, aes(x = year, y = mean_min)) +
  geom_line() +
  labs(title = "February Mean Minimum Tempratures", x = "Year", y = "Mean Min \nTemp (°C)")

plot_precipitation <- ggplot(data = almond_precip, aes(x = year, y = sum_p)) +
  geom_line() +
  labs(title = "January Precipitation", x = "Year", y = "Precipitation \n(mm)")

plot_yield/plot_precipitation/plot_temperature
```

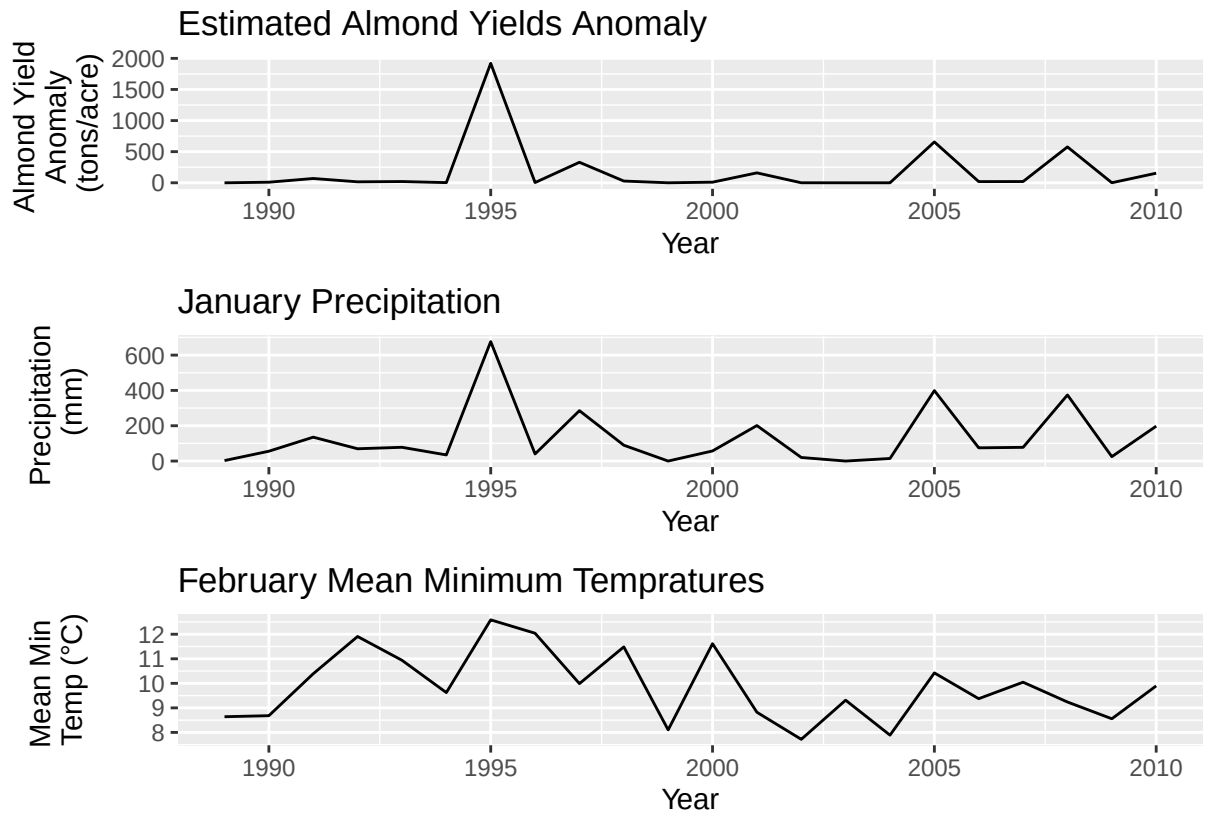

Figure 1: Almond yield anomaly plotted with graphs of January precipitation and minimum February temperatures. We can see that the anomaly is correlated with changes in the January precipitation.

```
# largest anomalies

yield %>%
  filter(almond_yield > 500)
```

```
##   almond_yield year
```

```
## 1    1919.9812 1995
## 2     656.3724 2005
## 3     576.2822 2008
```

```
all_data <- left_join(yield, almond_precip, by = "year")
all_data <- left_join(all_data, almond_temp, by = "year")

ggplot(all_data, aes(y = almond_yield, x = sum_p)) +
  geom_point() +
  labs(title = "Yield vs. Precipitation",
       y = "Almond Yield Anomaly (tons/acre)",
       x = "January Precipitation (mm)")
```

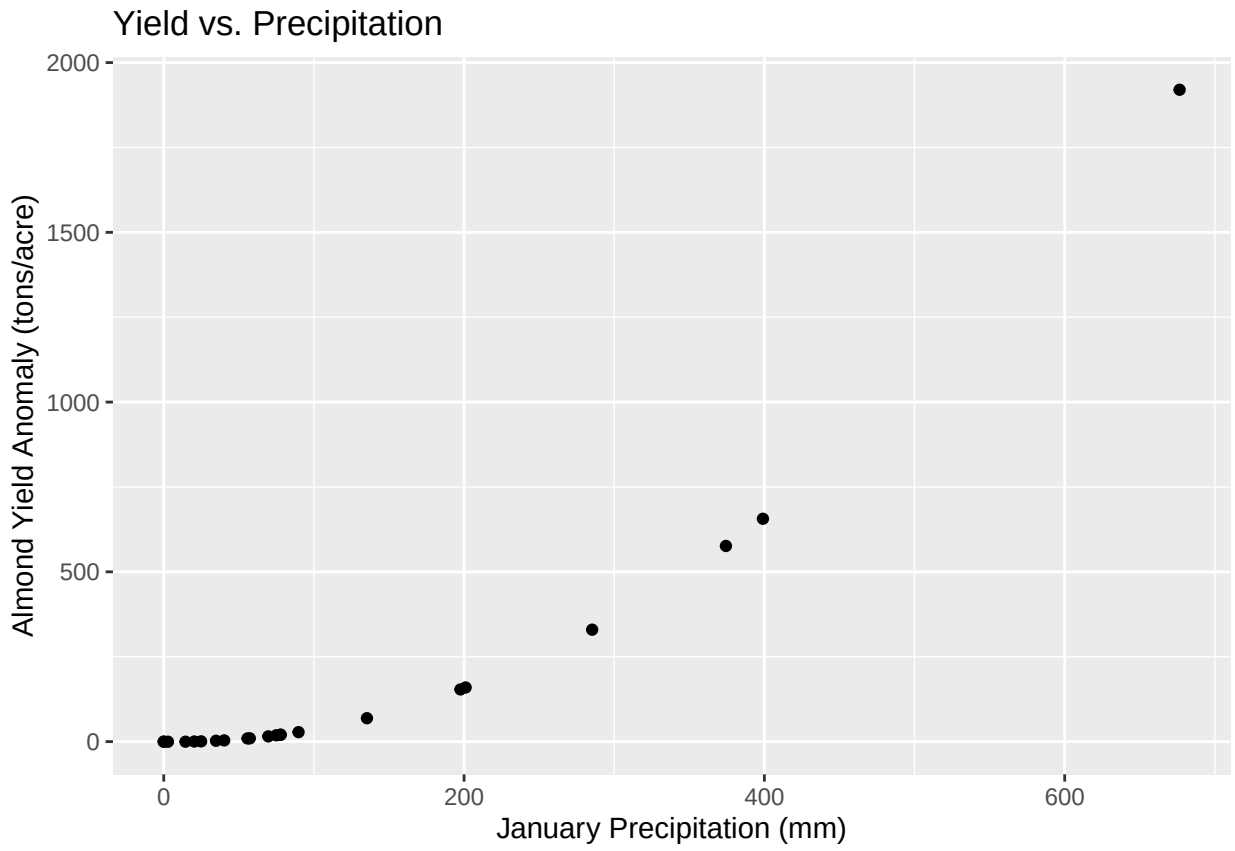

Figure 2: There is a strong relationship between the almond yield anomaly and January precipitation.

```
ggplot(all_data, aes(y = almond_yield, x = mean_min)) +
  geom_point() +
  labs(title = "Yield vs. Temperature",
       y = "Almond Yield (tons/acre)",
       x = "Minimum February Temperature (C)")
```

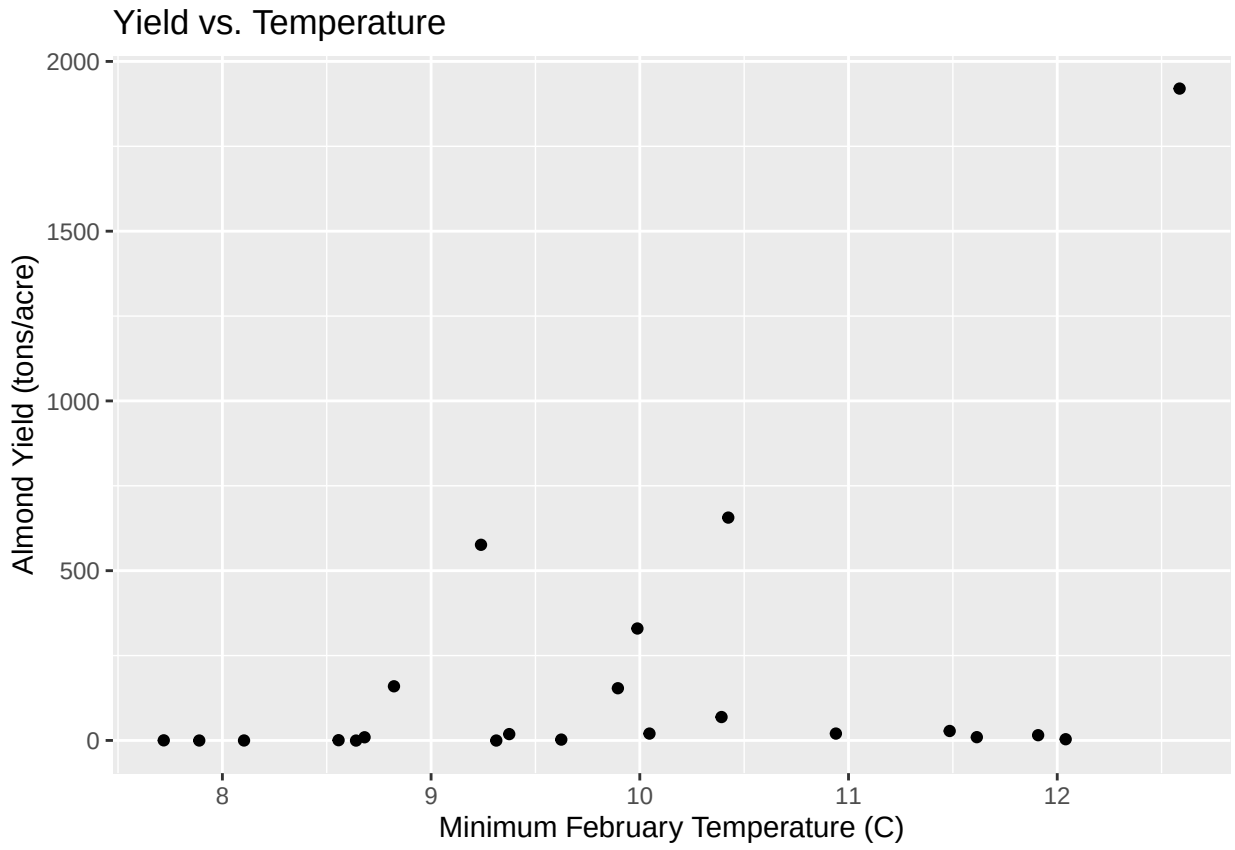

Figure 3: This figure does not show a relationship between almond yield anomaly and minimum Febrary temperature.

Summary paragraph

Based on these findings, 1995 was the year with the highest yield anomaly of 1919.981 tons/acre. 2005 and 2008 had the next largest anomalies, with 656.37 tons/acre and 576.28 tons/acre, respectively. Looking at the trends in anomalies compared with the trends in temperature and precipitation, it appears that the yield anomalies are highly correlated with variations in precipitation. This is further confirmed by plotting yield anomaly against January precipitation and minimum February temperature. There seems to be a strong relationship between almond yield anomaly and January precipitation, whereas there is no clear relationship between almond yield anomaly and minimum February temperature.