EDS 230 / ESM 232 Assignment - Almond Anomaly Summary

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Read in climate data and almond anomaly function:

```
# read in the climate data
data <- read.table("clim.txt", sep = " ", header = T)
```

```
# load in almond_anomaly.R function
source(here("almond_anomaly.R"))
```

Run `almond_anomaly()` function on climate data:

```
almond_anom <- almond_anomaly(data = data)
```

```
## `summarise()` has grouped output by 'year'. You can override using the `.groups`
## argument.
```

```
## [1] "The data is now wrangled. Starting anomaly calculation."
```

```
## Warning: `data_frame()` was deprecated in tibble 1.1.0.
## Please use `tibble()` instead.
```

Visually Summarize Results

```
library(gt)

almond_anom_table <- almond_anom %>%
  gt() %>%
  tab_header(
    title = md("**Almond Anomalies 1989 - 2010**")
  ) %>%
  fmt_passthrough(
  columns = c(year)
  ) %>%
  fmt_number(
  columns = c(almond_anomaly)
  ) %>%
  cols_label(year = "Year" ,
             almond_anomaly = "Almond Anomaly") %>%
  tab_style(
    style = list(
      cell_fill(color = "deepskyblue"),
```

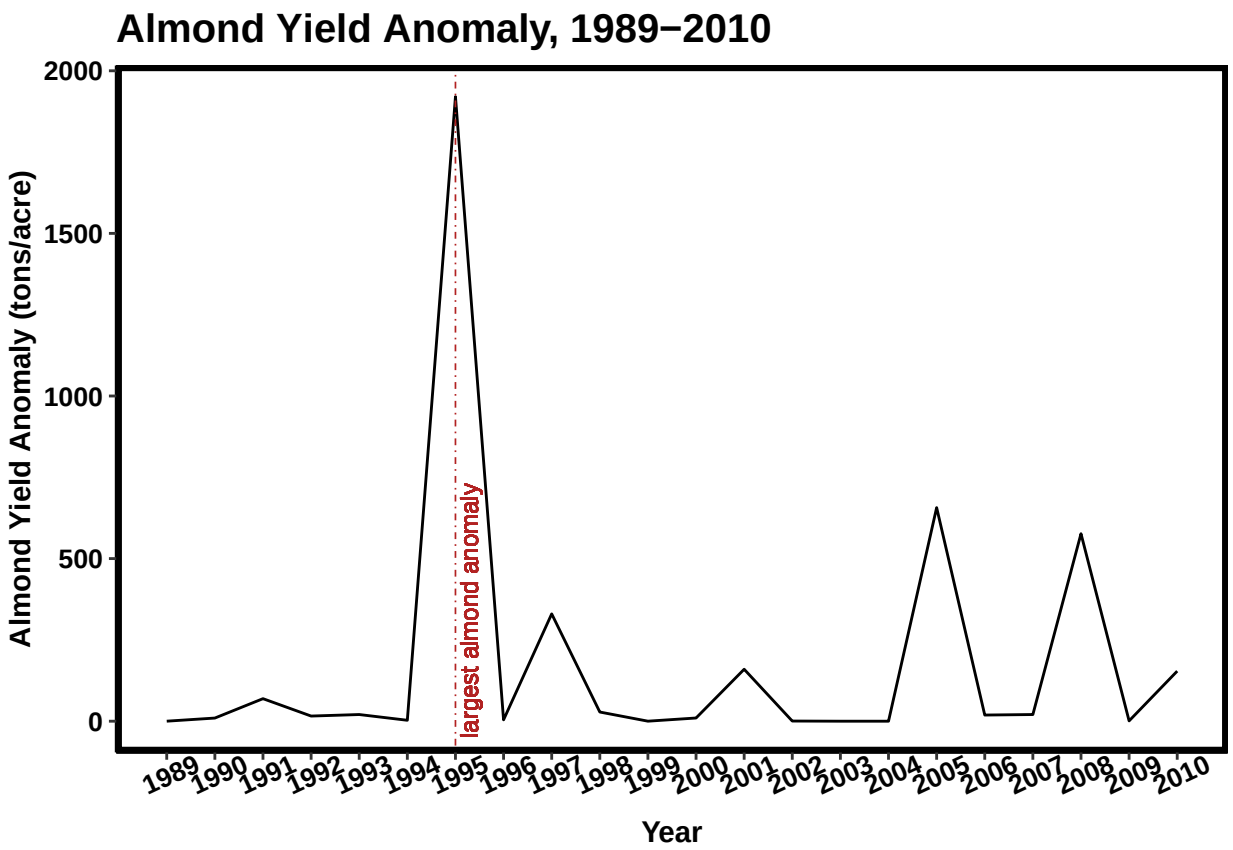
```
      cell_text(weight = "bold")
      ),
    locations = cells_body(
      columns = c(year, almond_anomaly))
  ) %>%
tab_style(
  style = list(
    cell_fill(color = "coral2"),
    cell_text(weight = "bold")
    ),
  locations = cells_body(
    columns = c(year, almond_anomaly),
    rows = year == "1995")
 ) %>%
  tab_source_note(source_note = "Data Source: Lobell et all. 2006: https://naomitague.github.io/ESM232_
  opt_align_table_header(align = "center") %>%
  cols_width(
    year ~ px(150),
    almond_anomaly ~ px(150)
  ) %>%
  cols_align(align = "center")

almond_anom_table
```

Almond Anomalies 1989 - 2010

Year	Almond Anomaly
1989	0.04
1990	9.67
1991	69.32
1992	15.82
1993	20.49
1994	2.86
1995	1,920.31
1996	4.19
1997	329.98
1998	28.20
1999	0.11
2000	9.81
2001	159.75
2002	0.46
2003	−0.03
2004	−0.01
2005	656.72
2006	18.96
2007	20.51
2008	576.54
2009	0.98
2010	154.00

Data Source: Lobell et all. 2006: https://naomitague.github.io/ESM232_course/assignments/lobell.2006.pdf

```
ggplot(data = almond_anom, aes(x = year, y = almond_anomaly)) +
  geom_line() +
  theme_classic() +
  ggtitle("Almond Yield Anomaly, 1989-2010") +
   xlab("Year") +
   ylab("Almond Yield Anomaly (tons/acre)") +
   theme(axis.title.x = element_text(color = "black", size = 11, face = "bold"),
         axis.text.x = element_text(face = "bold", color = "black", size = 10, angle = 25),
         axis.title.y = element_text(color = "black", size = 11, face = "bold"),
         axis.text.y = element_text(face = "bold", color = "black", size = 10),
         plot.title = element_text(color="black", size = 15, face = "bold"),
         panel.border = element_rect(colour = "black", fill = NA, size = 2)) +
  scale_x_continuous(breaks = seq(1989, 2010, by = 1)) +
  geom_vline(xintercept = 1995,
              size = 0.3,
             color = "firebrick",
             linetype = "dotdash") +
   geom_text(aes(x = 1995,
                 label = "largest almond anomaly",
                 y = 340),
             angle = 90,
             vjust = 1.3,
             size = 3,
             color = "firebrick")
```



Almond Anomaly Summary

The calculated anomaly for almond yield between 1989-2010 is displayed above in both table and graph form. The graph highlights an interesting pattern of productions spikes against an otherwise relatively constant rate: 2005, 2008, and most notably 1995 show substantial increases of almond yield; these years may act as starting points for future research into the factors that effect almond production (increased precipitation? new agricultural technology? decrease in pest population?).

When trying to understand these results, there is another consideration that is highlighted better in the table: every value except for 2003-04 is a positive value. This is a potential area for concern because the nominal calculation we are making here is anomaly, or deviation from the mean. But what mean? According to the caption for Figure 3 in Lobell et al. 2006, it is percent anomaly from 2000-2003 average yields. Interestingly, in our dataset this 2000-04 average looks more like a floor than a mean (particularly using the graph above). Writing as three people with very limited historical knowledge of the details of almond production, we are concerned that this may give a biased number for what constitutes a 'reasonable' amount of almond production. This is particularly important taken in the context of Lobell's work, which looks at forecasting effects of climate change on agricultural production: if the 2000-03 average yields are interpreted as a true average, then it would be expected that many years would fall below that value without any cause for concern. However, if that number is closer to a minimum expected yield (as the graph above seems to indicate), then any substantial or prolonged drop below the threshold should be much more concerning.

Citations

Climate data and almond anomaly model were sourced from Lobell et al. 2006