# Almond Yield Anomaly: Sensitivity Analysis & NPV

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```
# Install packages
library(tidyverse)
library(lubridate)
library(patchwork)
library(kableExtra)
library(tinytex)
library(purrr)
```

**Read in climate data and run yield_anomaly function**

```
# Read in data frame & convert date column (D) to a date
clim.df <- read.table('clim_edited.txt',header = TRUE) %>%
  mutate(
    D = as.Date(D)
  )

# Read in yield_anomaly.R function
# NOTE: function has been rewritten since the last assignment
source("yield_anomaly_v3.R")
source("compute_NPV.R")


# Some data wrangling before using it in the function/model
intermed.Jan <- clim.df %>%
  filter(month == 1) %>%
  group_by(year) %>%
  summarise(
    totprcp = sum(precip)
  )

intermed.Feb <- clim.df %>%
  filter(month == 2) %>%
  group_by(year) %>%
  summarise(
    mintemp = mean(tmin_c)
  )

# Vector of total precipitation in January
total_precip <- intermed.Jan$totprcp
# Vector of mean minimum daily temperature in February
```

```r
minimum_temps <- intermed.Feb$mintemp
# Vector of years with indices that match those of the precipitation and temperature vectors
anom_years <- as.numeric(intermed.Feb$year)
```

```r
# Run the function with clim.df using years 2000-2002 - looks good as of this run
# Checking again because yield_anomaly_v3.R uploads a new version of the yield_anonaly() function
test.years = c(2000,2001,2002)
test.precip = total_precip[12:14]
test.temp = minimum_temps[12:14]

# test.func <- yield_anomaly(precip = test.precip, min_temp = test.temp)
# test.func[1] # 9.59
# test.func[2] #159.51
# test.func[3] # 0.24
```

### Sensitivity Analysis

```r
# Vector of 500 randomly generated p2 coefficients
rand.p2 <- rnorm(n = 500, mean = 0.0043, sd = 0.001)
# Running the yield_anomaly() function for each year 500 times, using a different p2 coefficient each t
# Returns a dataframe with a number of rows equal to the number of years/length of the vectors input to
res = rand.p2 %>%
  map_dfc(~yield_anomaly(precip = total_precip,
                         min_temp = minimum_temps,
                         p2=.x))
```

```r
# Giving this res dataframe column names corresponding to the p2 coefficient used to generate those res
colnames(res) = rand.p2
# Adding another column with the years to which the results correspond
res$yrs <- anom_years
```

### Calculate profit and find NPV

```r
# Pivot the res dataframe to long format
resg = res %>%
  pivot_longer(!yrs,names_to="coeff_p2", values_to="anomaly")

ann_sum <- resg %>%
  group_by(yrs) %>%
  summarize(
    mean_anomaly = mean(anomaly),
    mean_yield = 1 + mean_anomaly,
    yield_value = 2.5*2000*mean_yield,
    net_profit = yield_value - 3800
  )

npv_sum <- ann_sum %>%
  mutate(npv = compute_NPV(net_profit, yrs - yrs[1], discount = 0.12))
```

```r
npv_all <- resg %>%
  mutate(
    yield = 1 + anomaly,
    yield_value = 2.5*2000*yield,
    profit = yield_value - 3800,
    npv_profit = compute_NPV(profit, yrs - yrs[1], discount = 0.12)
  )
```

**Figures**

```r
# Plotting the results for anomaly sensitivity analysis
boxplot1 <- ggplot(resg, aes(yrs, anomaly, group=yrs)) +
  geom_boxplot() +
  labs(y="Anomaly (tons/acre)", "Year")

boxplot1
```

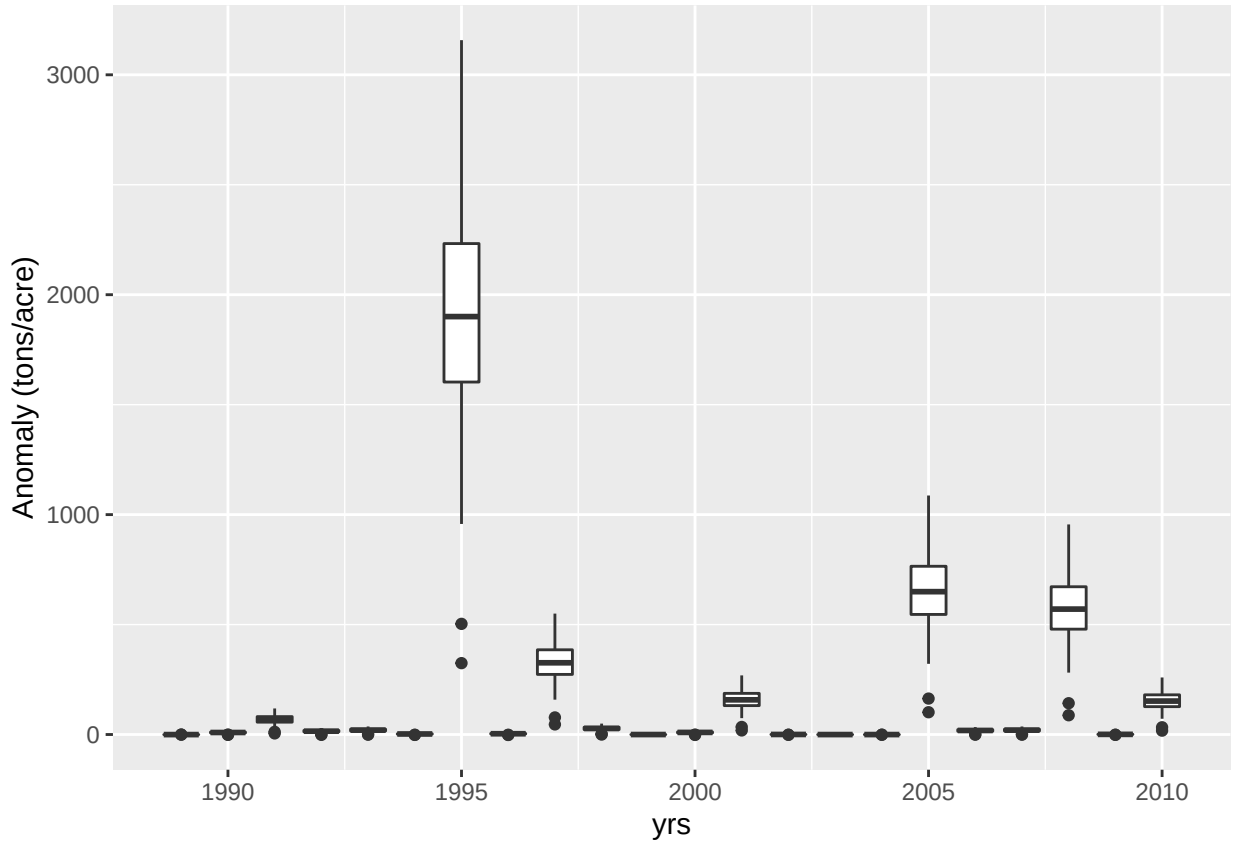


**Figure 1.** Boxplot of almond yield anomalies (tons/acre) by year.

```r
# Plotting the results of NPV
boxplot2 <- ggplot(npv_all, aes(yrs, npv_profit, group=yrs)) +
  geom_boxplot() +
  labs(y="NPV Profit ($/acre)", "Year")
```

```
boxplot2
```

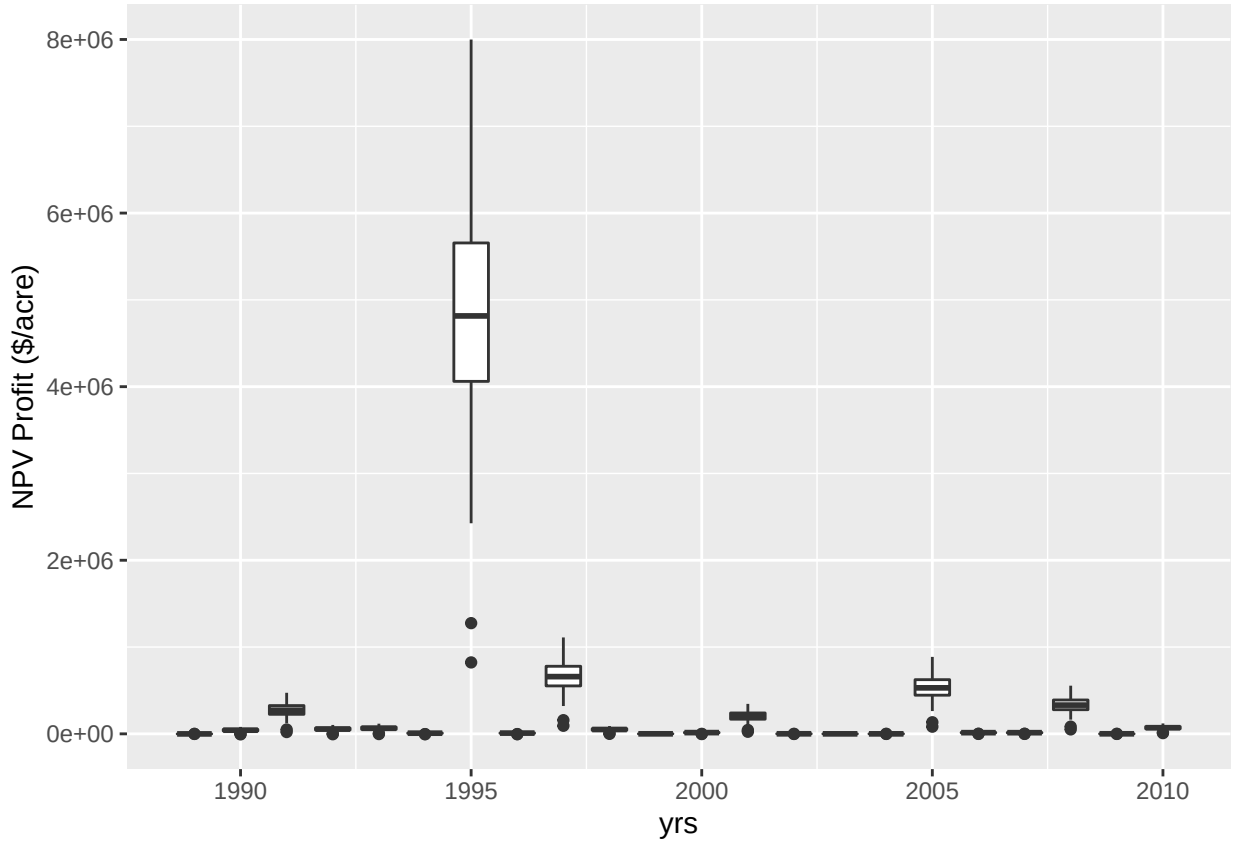


**Figure 2.** Boxplot of the net present value (NPV) of almond yield profits ($/acre) by year.