

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$totprcp
# Vector of mean minimum daily temperature in February
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minimum_temps <- intermed.Feb$mintemp
# Vector of years with indices that match those of the precipitation and temperature vectors
anom_years <- as.numeric(intermed.Feb$year)

# 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_anomaly() 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] # Should be 9.59

```

```
## [1] 9.599988
```

```
test.func[2] # Should be 159.51
```

```
## [1] 159.512
```

```
test.func[3] # Should be 0.24
```

```
## [1] 0.2450914
```

```

# 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 time
# 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))

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

```

```

# 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))

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)
  )
```

```
# Plotting the results - still a work in progress
boxplot1 <- ggplot(resg, aes(yrs, anomaly, group=yrs)) +
  geom_boxplot() +
  labs(y="Anomaly (tons/acre)", "Year")

boxplot1
```

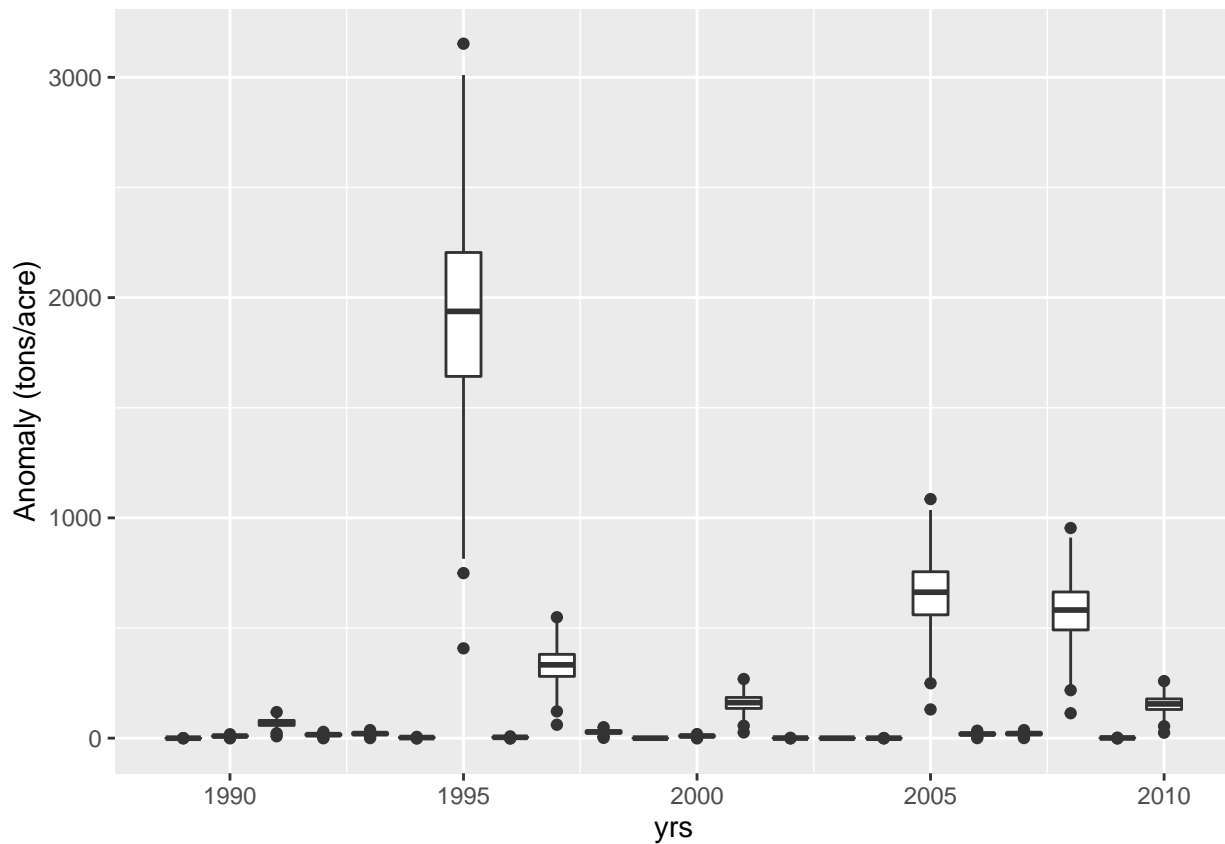


Figure 1. Boxplot of almond yield anomalies (tons/acre) by year.

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

boxplot2
```

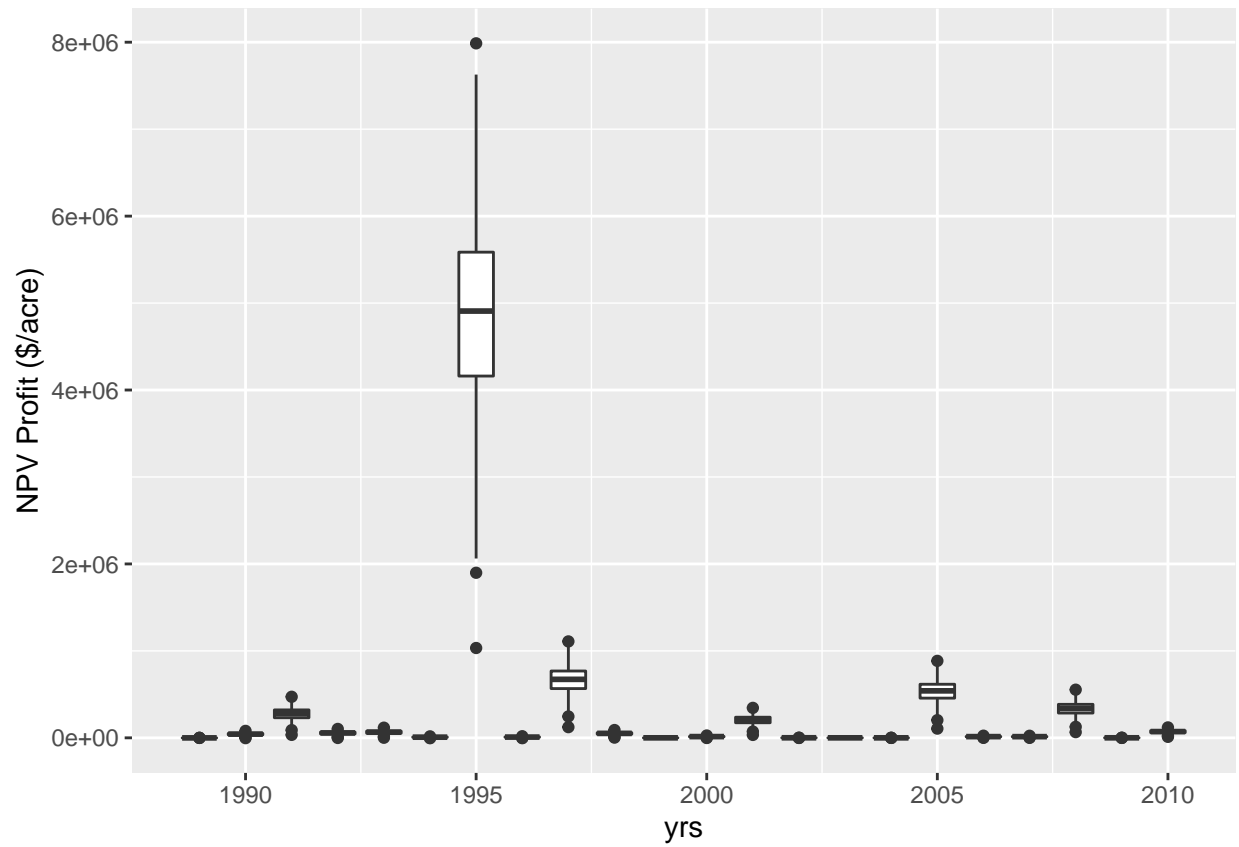


Figure 2. Boxplot of the net present value (NPV) of almond yield profits (\$/acre) by year.