

ESM 201 - Assignment 2

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1. Patterns in yield over time

a. Plot of yield over time by crop

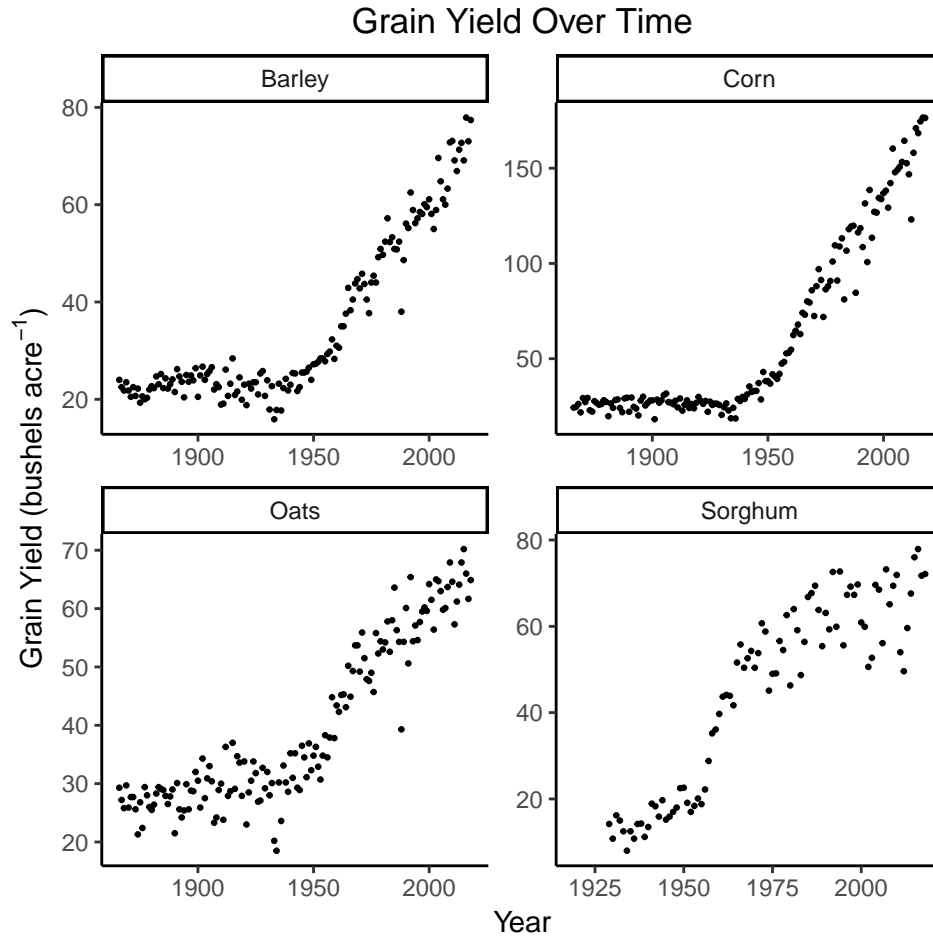


Figure 1 | Four plots showing grain yield over time by crop Grain yield is measured in bushels per acre. Barley, Corn and Oats look to have a linear low plateau for yield over time with positive slope starting in the 1940s. Sorghum looks to have a linear piecewise relationship for yield over time with an increasing rate starting in the 1950s but then decreasing rate starting in the 1970s.

b. Statistical models to describe Figure 1

Barley, Corn and Oats yield over time, seen in *Figure 1*, could be described by a linear low plateau model. For example, let $x = \text{year}$ and $f(x) = \text{Grain Yield (bushels acre}^{-1}\text{)}$. Then for Barley we have:

$$f(x) \approx \begin{cases} 25 & x \leq 1950 \\ 25 + \frac{4}{5}x & x > 1950 \end{cases}$$

For Corn yield, the slope would be steeper when $x > 1950$ at approximately $2x$. The slope for Oats yield when $x > 1950$ looks to be approximately $\frac{3}{5}x$. Sorghum shows a different trend that follows a linear piecewise relationship described by the following:

$$f(x) \approx \begin{cases} 15 + \frac{1}{5}x & 1925 \leq x \leq 1950 \\ 20 + \frac{6}{5}x & 1950 < x \leq 1975 \\ 50 + \frac{3}{5}x & 1975 < x \end{cases}$$

Notably, these yield increases all come during the green revolution.

2. Fertilizer use

a. Plot of fertilizer use over time by crop

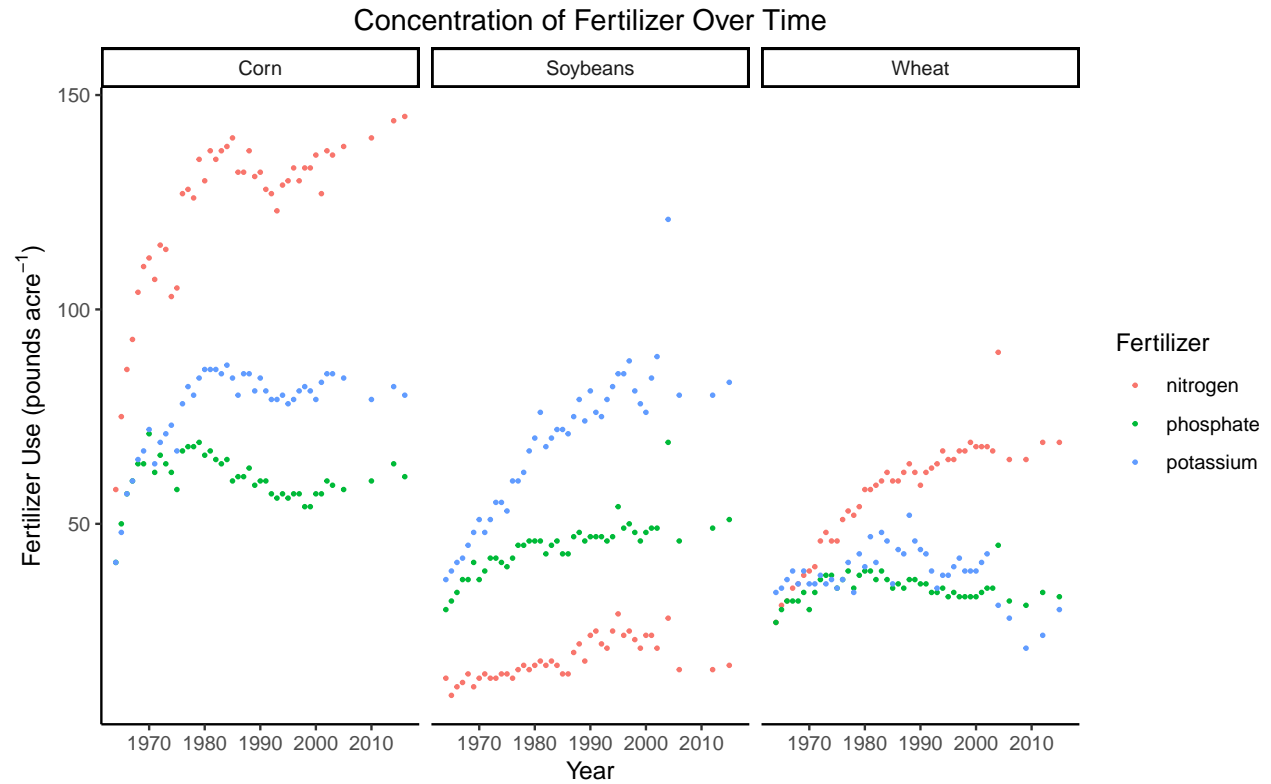


Figure 2 | Three plots showing pounds of fertilizer over time by crop.