Purchasing power of English workers from the 16th to the 19th century

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```
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.5     v dplyr   1.0.7
## v tidyr   1.1.4     v stringr 1.4.0
## v readr   2.0.2     v forcats 0.5.1
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

Introduction

The purpose of this peer-reviewed exercise to do a visualization of the data describing the purchasing power of workers in England between the 16th and 19th century. The data and accompanying visualization was first produced by William Playfair in his book: "A Letter on Our Agricultural Distresses, Their Causes and Remedies". After exploring the data, we divide this report into three main sections:

1. Reproducing Playfair's graph
2. Improving Playfair's graph
3. More graphical enhancements

Data exploration

We start by importing the data, displaying a few rows and showing some statistics.

```
data = read.csv('data.csv')
data[1:5,]
```

```
##   X Year Wheat Wages
## 1 1 1565  41.0  5.00
## 2 2 1570  45.0  5.05
## 3 3 1575  42.0  5.08
## 4 4 1580  49.0  5.12
## 5 5 1585  41.5  5.15
```

```
str(data)
```

```
## 'data.frame':    53 obs. of  4 variables:
##  $ X    : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ Year : int  1565 1570 1575 1580 1585 1590 1595 1600 1605 1610 ...
```

```
##  $ Wheat: num  41 45 42 49 41.5 47 64 27 33 32 ...
##  $ Wages: num  5 5.05 5.08 5.12 5.15 5.25 5.54 5.61 5.69 5.78 ...
```

1. Reproducing Playfair's graph

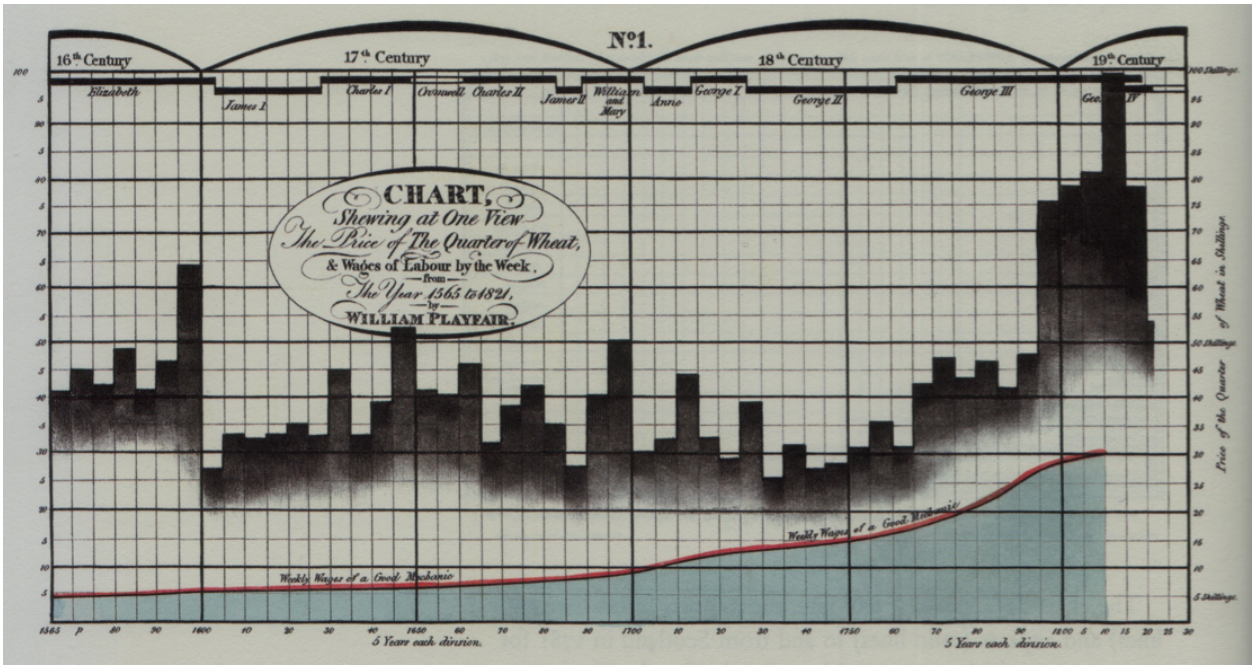


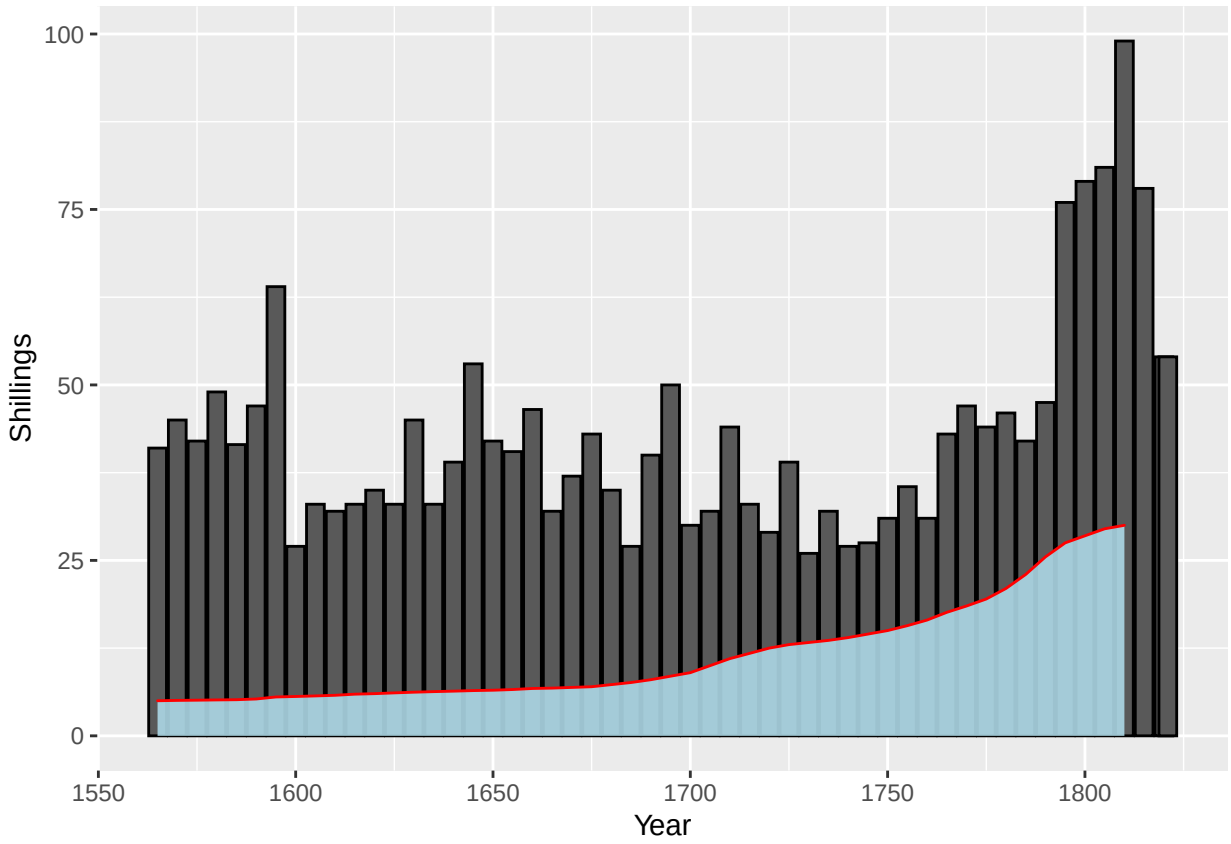
Figure 1: Chart of the Quarter of Wheat & Wages of Labour per week

```
ggplot(data=data, aes(x=Year, y=Wheat)) +
  geom_bar(aes(y=Wheat), position=position_dodge(0.9), colour="black", stat="identity", width=4.5, binw
  geom_area(aes(y=Wages), fill = "lightblue", color='red', alpha=0.9) +
  labs(y = "Shillings", x = "Year")
```

```
## Warning: Ignoring unknown parameters: binwidth
```

```
## Warning: position_dodge requires non-overlapping x intervals
```

```
## Warning: Removed 3 rows containing missing values (position_stack).
```



Comments

1. We can see from the wages curve that the there are missing values for the last few years. In the following section, we would remove these missing values as we cannot say much about purchasing power for that period.
2. Unlike the wages which are consistently increasing, the price of wheat does not have a consistent pattern.

2. Improving Playfair's graph

As mentioned in the previous section, we would like to remove missing values from the experiment. We can find these rows as follows:

```
data[rowSums(is.na(data)) > 0, ]
```

```
##     X Year Wheat Wages
## 51 51 1815    78    NA
## 52 52 1820    54    NA
## 53 53 1821    54    NA
```

```
df <- na.omit(data)
summary(df)
```

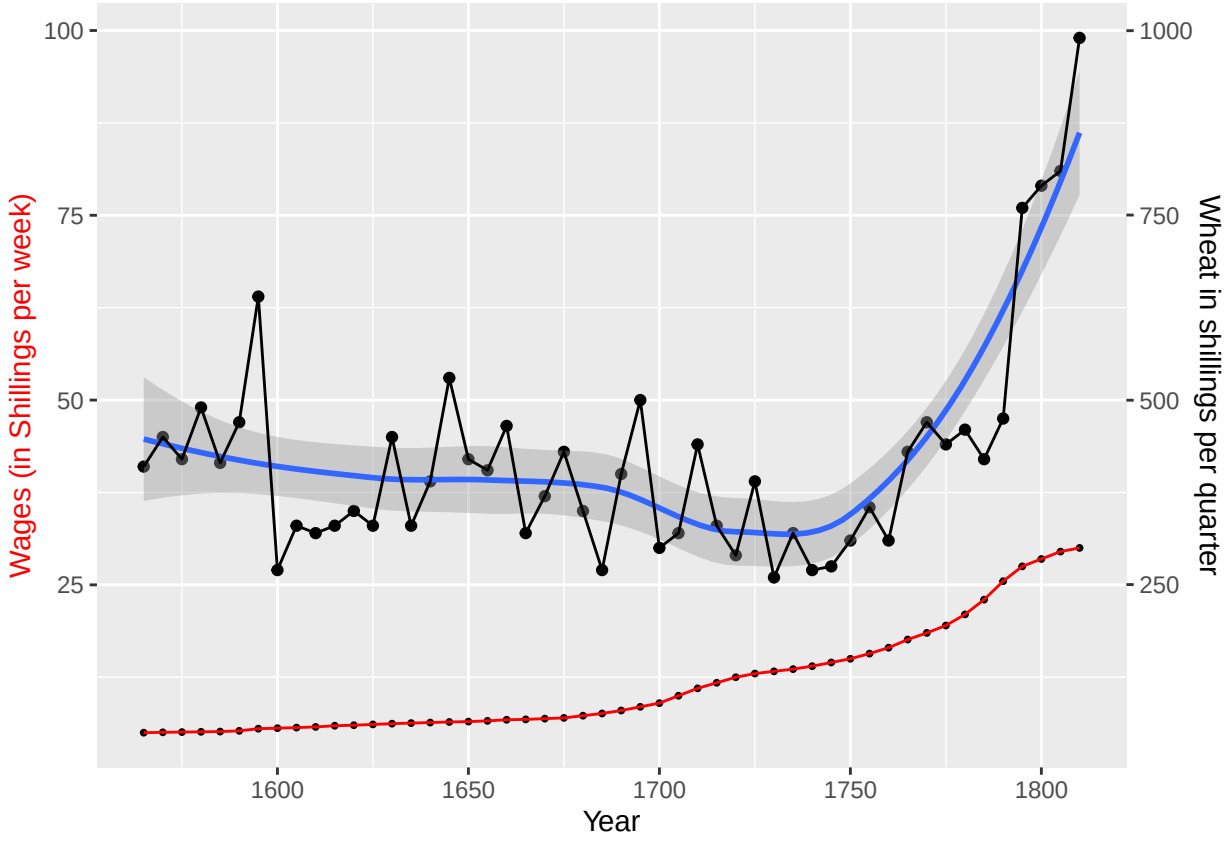
```
##        X              Year          Wheat           Wages
##  Min.   : 1.00   Min.   :1565   Min.   :26.00   Min.   : 5.000
##  1st Qu.:13.25   1st Qu.:1626   1st Qu.:32.25   1st Qu.: 6.145
##  Median :25.50   Median :1688   Median :40.25   Median : 7.800
##  Mean   :25.50   Mean   :1688   Mean   :42.14   Mean   :11.582
##  3rd Qu.:37.75   3rd Qu.:1749   3rd Qu.:45.75   3rd Qu.:14.875
```

```
##  Max.   :50.00   Max.   :1810   Max.   :99.00   Max.   :30.000
```

To improve the original graph we can add an additional y-axis label where the left side is the price of wheat in shillings per quarter and the right side is the wages in shillings per week.

```
ggplot(df) +
  aes(x = Year) +
  geom_point(aes(y=Wheat)) +
  geom_point(aes(y=Wages), size=0.7) +
  geom_smooth(aes(y=Wheat)) +
  geom_line(aes(y=Wheat)) +
  geom_line(aes(y=Wages), color='red') +
  scale_y_continuous( name = "Wages (in Shillings per week)", sec.axis = sec_axis( trans=~.*10, name="W
  theme(axis.title.y.left = element_text(colour = "red"))
```

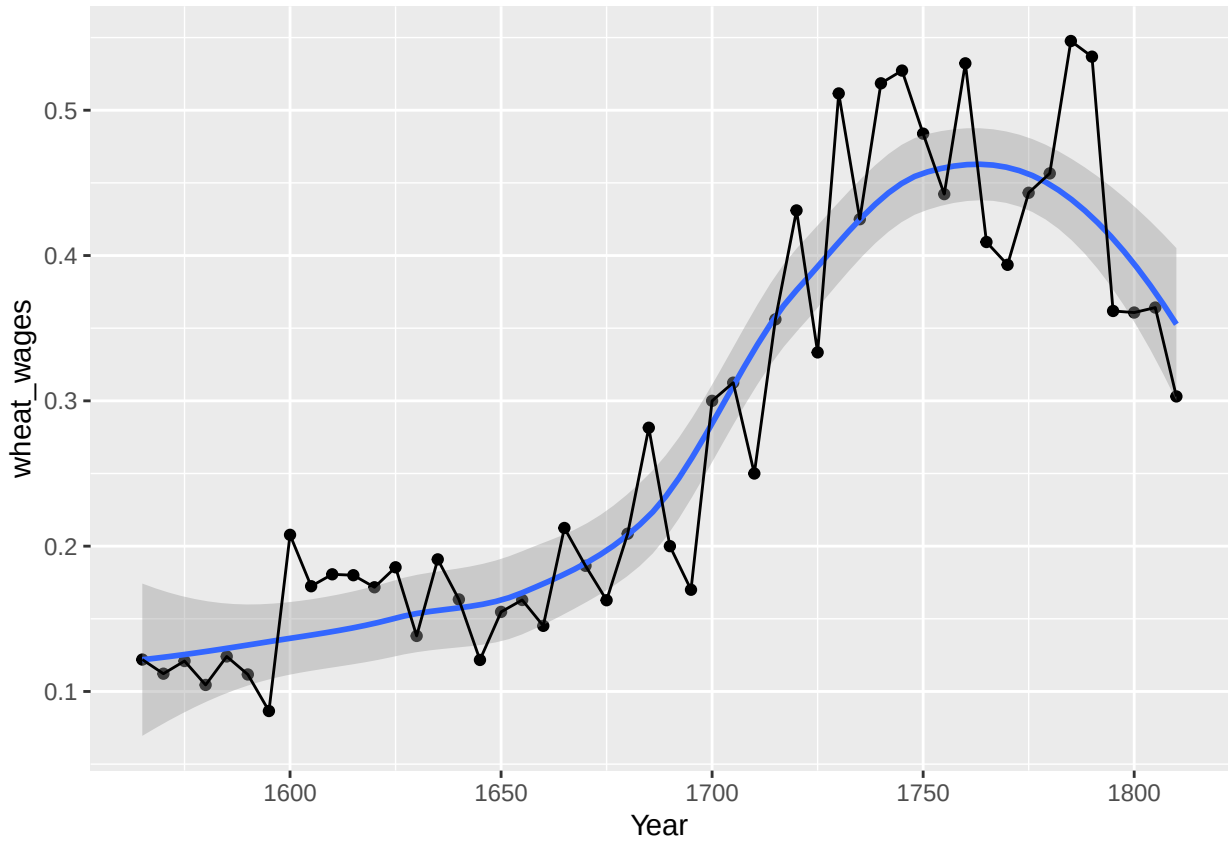
```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```



3. More graphical enhancements

```
df <- transform(df, wheat_wages = Wages / Wheat)
ggplot(df) +
  aes(x = Year) +
  geom_point(aes(y=wheat_wages)) +
  geom_smooth(aes(y=wheat_wages)) +
  geom_line(aes(y=wheat_wages))
```

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```


wheat_wages
0.5
0.4
0.3
0.2
0.1
1600
1650
1700
1750
1800
Year