

# MA388 Sabermetrics: Lesson 4

## Introduction to R Graphics - Part I

```
library(Lahman)
library(tidyverse)
library(knitr)
```

Henry (“Hank”) Aaron (1934-2021)

### ***Hank Aaron, Home Run King Who Defied Racism, Dies at 86***

He held the most celebrated record in sports for more than 30 years.

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Hank Aaron was among the greatest all-around players in baseball history, earning his home run record in the face of hate mail and even death threats. Mark Rucker/Transcendental Graphics, via Getty Images

Figure 1: Henry Aaron (Source: *New York Times*)

## Review

### Key Concepts

- five tidyverse verbs

- relational databases
- split, apply, combine

#### Review Question

- Using the **Batting** data frame, determine who held the *career* home run record by season from 1900 to the present. In other words, produce a table with one row per season indicating who the current career home run leader was in baseball at that time. Add their full name to the table using the **People** data frame.

Here is one approach:

- Add a column to the **Batting** data frame indicating each player's cumulative home runs (hint: `cumsum()`) at the end of the season.
- Write a function that takes a data frame and a year as arguments and returns the player with the most career home runs that year or earlier.
- Map the function over the seasons from 1900 to 2021.
- Add player information from the **People** data frame.

Table 1: Career home run leader by season. `yearID` indicates the season the record was set.

year	playerID	HRcareer	yearID	nameFirst	nameLast
1900	connoro01	138	1897	Roger	Connor
1901	connoro01	138	1897	Roger	Connor
1902	connoro01	138	1897	Roger	Connor
1903	connoro01	138	1897	Roger	Connor
1904	connoro01	138	1897	Roger	Connor
1905	connoro01	138	1897	Roger	Connor
1906	connoro01	138	1897	Roger	Connor
1907	connoro01	138	1897	Roger	Connor
1908	connoro01	138	1897	Roger	Connor
1909	connoro01	138	1897	Roger	Connor
1910	connoro01	138	1897	Roger	Connor
1911	connoro01	138	1897	Roger	Connor
1912	connoro01	138	1897	Roger	Connor
1913	connoro01	138	1897	Roger	Connor
1914	connoro01	138	1897	Roger	Connor
1915	connoro01	138	1897	Roger	Connor

year	playerID	HRcareer	yearID	nameFirst	nameLast
1916	connoro01	138	1897	Roger	Connor
1917	connoro01	138	1897	Roger	Connor
1918	connoro01	138	1897	Roger	Connor
1919	connoro01	138	1897	Roger	Connor
1920	connoro01	138	1897	Roger	Connor
1921	ruthba01	162	1921	Babe	Ruth
1922	ruthba01	197	1922	Babe	Ruth
1923	ruthba01	238	1923	Babe	Ruth
1924	ruthba01	284	1924	Babe	Ruth
1925	ruthba01	309	1925	Babe	Ruth
1926	ruthba01	356	1926	Babe	Ruth
1927	ruthba01	416	1927	Babe	Ruth
1928	ruthba01	470	1928	Babe	Ruth
1929	ruthba01	516	1929	Babe	Ruth
1930	ruthba01	565	1930	Babe	Ruth
1931	ruthba01	611	1931	Babe	Ruth
1932	ruthba01	652	1932	Babe	Ruth
1933	ruthba01	686	1933	Babe	Ruth
1934	ruthba01	708	1934	Babe	Ruth
1935	ruthba01	714	1935	Babe	Ruth
1936	ruthba01	714	1935	Babe	Ruth
1937	ruthba01	714	1935	Babe	Ruth
1938	ruthba01	714	1935	Babe	Ruth
1939	ruthba01	714	1935	Babe	Ruth
1940	ruthba01	714	1935	Babe	Ruth
1941	ruthba01	714	1935	Babe	Ruth
1942	ruthba01	714	1935	Babe	Ruth
1943	ruthba01	714	1935	Babe	Ruth
1944	ruthba01	714	1935	Babe	Ruth
1945	ruthba01	714	1935	Babe	Ruth
1946	ruthba01	714	1935	Babe	Ruth
1947	ruthba01	714	1935	Babe	Ruth
1948	ruthba01	714	1935	Babe	Ruth
1949	ruthba01	714	1935	Babe	Ruth
1950	ruthba01	714	1935	Babe	Ruth
1951	ruthba01	714	1935	Babe	Ruth
1952	ruthba01	714	1935	Babe	Ruth
1953	ruthba01	714	1935	Babe	Ruth
1954	ruthba01	714	1935	Babe	Ruth
1955	ruthba01	714	1935	Babe	Ruth
1956	ruthba01	714	1935	Babe	Ruth
1957	ruthba01	714	1935	Babe	Ruth
1958	ruthba01	714	1935	Babe	Ruth
1959	ruthba01	714	1935	Babe	Ruth

year	playerID	HRcareer	yearID	nameFirst	nameLast
1960	ruthba01	714	1935	Babe	Ruth
1961	ruthba01	714	1935	Babe	Ruth
1962	ruthba01	714	1935	Babe	Ruth
1963	ruthba01	714	1935	Babe	Ruth
1964	ruthba01	714	1935	Babe	Ruth
1965	ruthba01	714	1935	Babe	Ruth
1966	ruthba01	714	1935	Babe	Ruth
1967	ruthba01	714	1935	Babe	Ruth
1968	ruthba01	714	1935	Babe	Ruth
1969	ruthba01	714	1935	Babe	Ruth
1970	ruthba01	714	1935	Babe	Ruth
1971	ruthba01	714	1935	Babe	Ruth
1972	ruthba01	714	1935	Babe	Ruth
1973	ruthba01	714	1935	Babe	Ruth
1974	aaronha01	733	1974	Hank	Aaron
1975	aaronha01	745	1975	Hank	Aaron
1976	aaronha01	755	1976	Hank	Aaron
1977	aaronha01	755	1976	Hank	Aaron
1978	aaronha01	755	1976	Hank	Aaron
1979	aaronha01	755	1976	Hank	Aaron
1980	aaronha01	755	1976	Hank	Aaron
1981	aaronha01	755	1976	Hank	Aaron
1982	aaronha01	755	1976	Hank	Aaron
1983	aaronha01	755	1976	Hank	Aaron
1984	aaronha01	755	1976	Hank	Aaron
1985	aaronha01	755	1976	Hank	Aaron
1986	aaronha01	755	1976	Hank	Aaron
1987	aaronha01	755	1976	Hank	Aaron
1988	aaronha01	755	1976	Hank	Aaron
1989	aaronha01	755	1976	Hank	Aaron
1990	aaronha01	755	1976	Hank	Aaron
1991	aaronha01	755	1976	Hank	Aaron
1992	aaronha01	755	1976	Hank	Aaron
1993	aaronha01	755	1976	Hank	Aaron
1994	aaronha01	755	1976	Hank	Aaron
1995	aaronha01	755	1976	Hank	Aaron
1996	aaronha01	755	1976	Hank	Aaron
1997	aaronha01	755	1976	Hank	Aaron
1998	aaronha01	755	1976	Hank	Aaron
1999	aaronha01	755	1976	Hank	Aaron
2000	aaronha01	755	1976	Hank	Aaron
2001	aaronha01	755	1976	Hank	Aaron
2002	aaronha01	755	1976	Hank	Aaron
2003	aaronha01	755	1976	Hank	Aaron

year	playerID	HRcareer	yearID	nameFirst	nameLast
2004	aaronha01	755	1976	Hank	Aaron
2005	aaronha01	755	1976	Hank	Aaron
2006	aaronha01	755	1976	Hank	Aaron
2007	bondsba01	762	2007	Barry	Bonds
2008	bondsba01	762	2007	Barry	Bonds
2009	bondsba01	762	2007	Barry	Bonds
2010	bondsba01	762	2007	Barry	Bonds
2011	bondsba01	762	2007	Barry	Bonds
2012	bondsba01	762	2007	Barry	Bonds
2013	bondsba01	762	2007	Barry	Bonds
2014	bondsba01	762	2007	Barry	Bonds
2015	bondsba01	762	2007	Barry	Bonds
2016	bondsba01	762	2007	Barry	Bonds
2017	bondsba01	762	2007	Barry	Bonds
2018	bondsba01	762	2007	Barry	Bonds
2019	bondsba01	762	2007	Barry	Bonds
2020	bondsba01	762	2007	Barry	Bonds
2021	bondsba01	762	2007	Barry	Bonds
2022	bondsba01	762	2007	Barry	Bonds
2023	bondsba01	762	2007	Barry	Bonds
2024	bondsba01	762	2007	Barry	Bonds
2025	bondsba01	762	2007	Barry	Bonds

## Plotting using ggplot

In this course, we will use `ggplot` for graphics. While the code initially seems more complex, `ggplot` allows us to easily add variables to plots using aesthetics. Here are a few aesthetics `ggplot` makes available:

- color
- fill
- linetype
- linewidth
- shape

### Long vs. Wide Format

With `ggplot`, you will typically want data in long format as opposed to wide format. What's the difference?

```
# Here are Hank Aaron's and Carl Yastrzemski's HR totals for 1965-70.
data_long <- Batting |>
  filter(yearID >= 1965,
         yearID <= 1970,
         playerID %in% c("aaronha01", "yastrca01")) |>
  select(yearID, playerID, HR)

# This data is in long format.
data_long |> kable()
```

yearID	playerID	HR
1965	aaronha01	32
1966	aaronha01	44
1967	aaronha01	39
1968	aaronha01	29
1969	aaronha01	44
1970	aaronha01	38

yearID	playerID	HR
1965	yastrca01	20
1966	yastrca01	16
1967	yastrca01	44
1968	yastrca01	23
1969	yastrca01	40
1970	yastrca01	40

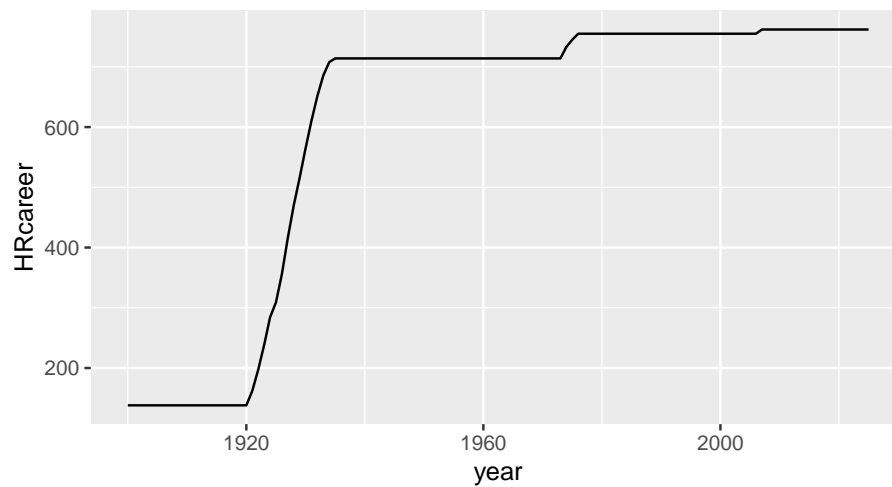
```
data_wide <- data_long |>
  pivot_wider(id_cols = playerID, names_from = yearID, values_from = HR)

# This data is in wide format.
data_wide |> kable()
```

playerID	1965	1966	1967	1968	1969	1970
aaronha01	32	44	39	29	44	38
yastrca01	20	16	44	23	40	40

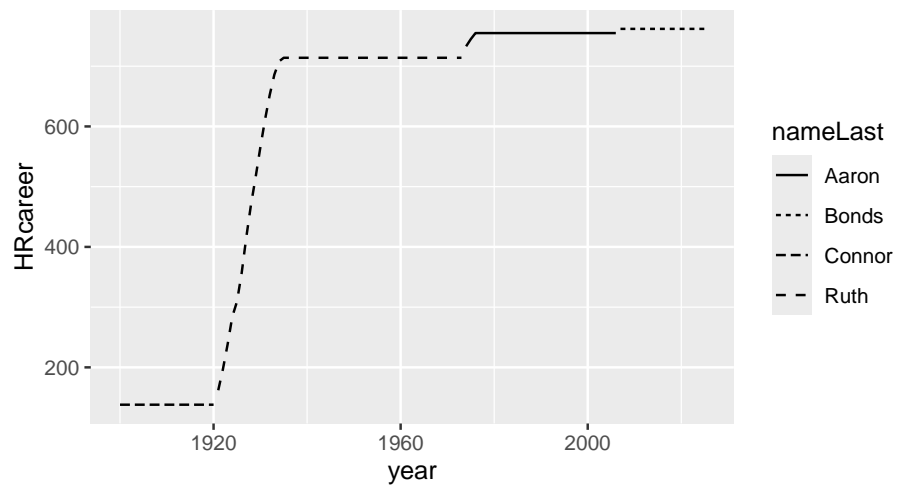
A basic ggplot has the data frame, aesthetic, and at least one layer. Going back to the Review, let's plot the number of home runs for the career home run leader by year.

```
leaders |>
  ggplot(aes(x = year,
             y = HRcareer)) +
  geom_line()
```



Now, let's add the player's name to the plot:

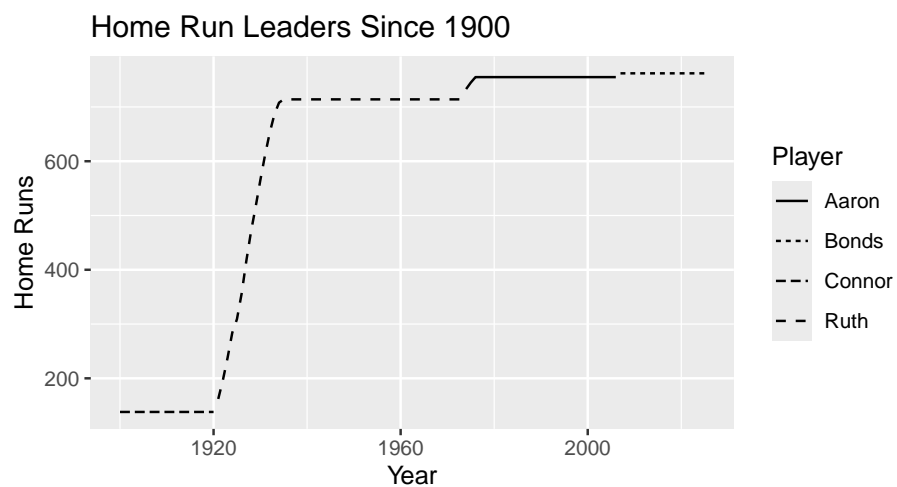
```
leaders |>
  ggplot(aes(x = year,
             y = HRcareer,
             linetype = nameLast)) +
  geom_line()
```



Next, let's change the labels:

```
leaders |>
  ggplot(aes(x = as.numeric(year),
             y = HRcareer,
             linetype = nameLast)) +
  geom_line() +
  labs(title = "Home Run Leaders Since 1900",
       x = "Year",
       y = "Home Runs",
       linetype = "Player")
```





### Your Turn

Using the `Batting` data frame, plot a scatter plot of Hank Aaron's home runs ( $y$ -axis) vs. batting average ( $x$ -axis) by season. Color the points in the plot by team name. Change the labels to "Home Runs", "Batting Average", and "Team".

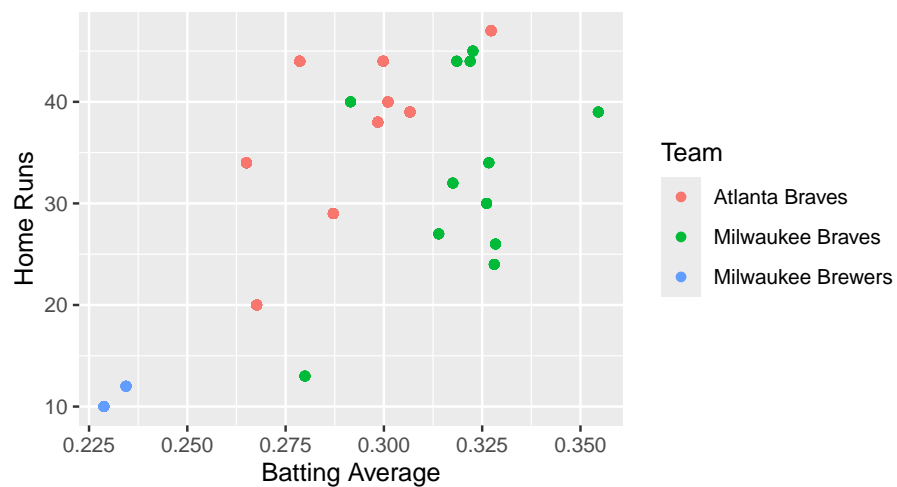


Figure 2: Hank Aaron's home runs vs. batting average by year and team.