Midterm Project

Stat 133, Fall 2016, Prof. Sanchez

Due Date: October 21, 2016

Abstract: The purpose of this project is to put in practice the main concepts that we've seen so far in the course:

- working with various types of data objects
- using control flow structures
- writing functions
- manipulation of character strings with `"stringr"`
- data manipulation with `"dplyr"`
- data visualization with `"ggplot2"`

It is possible that you may need to learn new concepts (and consult topics) not covered during lecture or lab.

General Instructions

Please use the provided `.Rmd` and `.R` file templates available in bCourses. And don't forget to include your name!

When writing commands and functions for this assignment:

- Use a consistent naming style.
- Include a description of what the function does.
- Include a description for the expected input(s) of a function.
- Include a description for the returned output of a function.
- Avoid writing long functions, and strive to limit the number of lines in the body of a function to less than 10 lines of code.
- Likewise, limit the line-width of your code to a max of 80 characters. If you have long lines, then split them into shorter lines, e.g.:

```
# avoid long line
dat = read.csv("~/Documents/stat133/project1/data/dataset.csv", stringsAsFactors = FALSE)

# better (split long lines)
dat = read.csv(
  "~/Documents/stat133/project1/data/dataset.csv",
  stringsAsFactors = FALSE)
```

- Include comments but don't belavor the obvious.
- Use white spaces:

```
# avoid lack of spaces
dat=read.csv("dataset.csv",header=FALSE,row.names=1,dec=';',skip=1)
a=seq(from=1,to=100,by=1)

# better (use spaces!)
dat = read.csv("dataset.csv", header = FALSE, row.names = 1, dec = ';', skip = 1)
a = seq(from = 1, to = 100, by = 1)
```

- Use indentation (RStudio usually does this for you).
- Lack of indentation, lack of white spaces, inconsistent naming style, lines exceeding 80 chars-width, and code that in general is hard to "read" or "review" will be penalized.
- If you are not sure about the appearance of your code, apply code reformatting by using the `Reformat Code` option from `Code` in RStudio's menu bar.

In addition to checking whether you meet all the listed project requirements, we will evaluate the following core competencies of your report:

- **Computation:** Perform computations correctly.
- **Analysis:** Carry out analysis appropriate for data and context.
- **Synthesis:** Identify key features of the analysis, and interpret results.
- **Visual presentation:** communicate findings graphically clearly.
- **Verbal:** communicate findings in writing clearly, precisely and concisely.

This project is an individual project. You may discuss its different parts with other students, but you must independently write your code and solutions. For example, suggesting a function or a package to another student is acceptable, whereas simply giving him or her your own code is not. If you are not clear about the expectations for completing this assignment, be sure to seek clarification from the instructor or GSI beforehand.

We reserve the right to meet with you and ask you questions (verbally, in written form, or coding in Rstudio) about your submitted project, your code, and the approach that you use to solve the questions. Failing to have such a meeting may cause loosing all points in this project.

About the Data Sets

High Jump World Records

You will be working with data about High Jump World Records for both women and men (see screenshots below). The original sources are available in wikipedia:

- https://en.wikipedia.org/wiki/Women%27s_high_jump_world_record_progression
- https://en.wikipedia.org/wiki/Men%27s_high_jump_world_record_progression

Height	Athlete	Date	Place
1.46 m (4 ft 9½ in)	Nancy Voorhees (USA)	20 May 1922	Simsbury[1]
1.485 m (4 ft 10½ in)	Elizabeth Stine (USA)	26 May 1923	Leonia[1]
1.485 m (4 ft 10½ in)	Sophie Eliott-Lynn (GBR)	6 August 1923	Brentwood[1]
1.524 m (5 ft 0 in)	Phyllis Green (GBR)	11 July 1925	London[1]
1.552 m (5 ft 1⅛ in)	Phyllis Green (GBR)	2 August 1926	London[1]
1.58 m (5 ft 2¼ in)	Ethel Catherwood (CAN)	6 September 1926	Regina[1]
1.58 m (5 ft 2¼ in)	Lien Gisolf (NED)	3 July 1928	Brussels[1]

Height	Athlete	Venue	Date
2.00 m (6 ft 6¾ in)	George Horine (USA)	Palo Alto, California	18 May 1912[1]
2.022 m (6 ft 7⅝ in)	Edward Beeson (USA)	Berkeley, California	2 May 1914[3]
2.038 m (6 ft 8¼ in)	Harold Osborn (USA)	Urbana, Illinois	27 May 1924[4]
2.04 m (6 ft 8⅜ in)	Walter Marty (USA)	Fresno, California	13 May 1933[1]
2.06 m (6 ft 9⅛ in)	Walter Marty (USA)	Palo Alto, California	28 April 1934[1]
2.07 m (6 ft 9½ in)	Cornelius Johnson (USA)	New York	12 July 1936[1]
2.07 m (6 ft 9½ in)	Dave Albritton (USA)	New York	12 July 1936[1]

I've scraped the data tables and saved them in two CSV files available in the course's github repository:

- https://raw.githubusercontent.com/ucb-stat133/stat133-fall-2016/master/data/womens-high-jump-raw.csv
- https://raw.githubusercontent.com/ucb-stat133/stat133-fall-2016/master/data/mens-high-jump-raw.csv

About the Problems

This project is divided in five parts (please follow further instructions in the `.Rmd` template file available on bCourses):

- **Functions:** programming auxiliary functions that will help you clean the raw data sets.
- **Data cleaning:** this part involves working with the raw messy data sets in order to produce two clean data frames: one for women, one for men.
- **Exploratory Data Analysis:** this has to do with computing a series of summary measures, and summary tables.
- **Data Visualization:** production of various plots that allow the audience to look at the progression of high jump world records.
- **Model Fitting:** consists of fitting a least squares regression line to model the height values in terms of time. This model will be used to extrapolate what the world records could have been various years.

It is possible you may need to learn about functions and/or other R capabilities that we didn't cover in lecture, labs, or HW. If you believe there is a concept that falls in this category, google it first. If you don't find any information, or the concepts are still unclear, then ask the lab assistants, GSIs, or the instructor.

Functions

To clean the raw data sets you must write various functions. All the code for the functions must be written in an `.R` script using the provided template file. Some functions that you may find useful are `str_extract()`, `str_split()`, `str_replace()`, and/or `str_sub()`, from the package "`stringr`".

Extract Height: write a function to extract the numbers corresponding to the height value in meters. This function will help you clean the column `Height`. The output must be a **numeric** vector with the values for the records (corresponding to meters).

Extract Athlete's Name: write a function to extract the names of the athletes. This function will help you clean the column `Athlete`. This column contains the name of the athlete, together with the country (inside parenthesis). Your function must return a character vector with just the first and last names of athletes.

Extract Country: write a function to extract the name of the countries. This function will help you clean the column `Athlete` by extracting just the abbreviation of the countries. Your function must return a character vector containing the initials of the countries (without no parenthesis): e.g. `"USA", "USA", "GBR", ...`.

Remove Brackets: write a function to remove the brackets (and the numbers inside them), that appear in some of the columns of both data sets (e.g. column `Date` for mens, column `Place` for womens). This function must return a "clean"" character vector with no brackets (and no numbers inside the brackets).

Extract Day: write a function to extract the day number of the column `Date`. This function must return a numeric vector with such day numbers.

Extract Month: write a function to extract the name of the month from the column `Date`. This function must return a character vector with the names of the months.

Reformat Date: write a function to reformat the date. This function must return a vector of class `"Date"` with format `"%d %B %Y"`.

Extract City: write a function to extract the city name from the column `Place` (for womens data). This function must return a character vector with just the name fo the city.

Clean data sets:

Your clean `womens` data frame should look like this one (6 first rows displayed)

```
  height         athlete gender country      city       date day  month year
1  1.460  Nancy Voorhees female     USA  Simsbury 1922-05-20  20    May 1922
2  1.485 Elizabeth Stine female     USA    Leonia 1923-05-26  26    May 1923
3  1.485   Sophie Eliott female     GBR Brentwood 1923-08-06   6 August 1923
4  1.524   Phyllis Green female     GBR    London 1925-07-11  11   July 1925
5  1.552   Phyllis Green female     GBR    London 1926-08-02   2 August 1926
```

Your clean `mens` data frame should look like this one (6 first rows displayed)

```
  height       athlete gender country      city       date day month year
1  2.000 George Horine   male     USA Palo Alto 1912-05-18  18   May 1912
2  2.022 Edward Beeson   male     USA  Berkeley 1914-05-02   2   May 1914
3  2.038 Harold Osborn   male     USA    Urbana 1924-05-27  27   May 1924
4  2.040  Walter Marty   male     USA    Fresno 1933-05-13  13   May 1933
5  2.060  Walter Marty   male     USA Palo Alto 1934-04-28  28 April 1934
```

Your merged `records` data frame should have this structure:

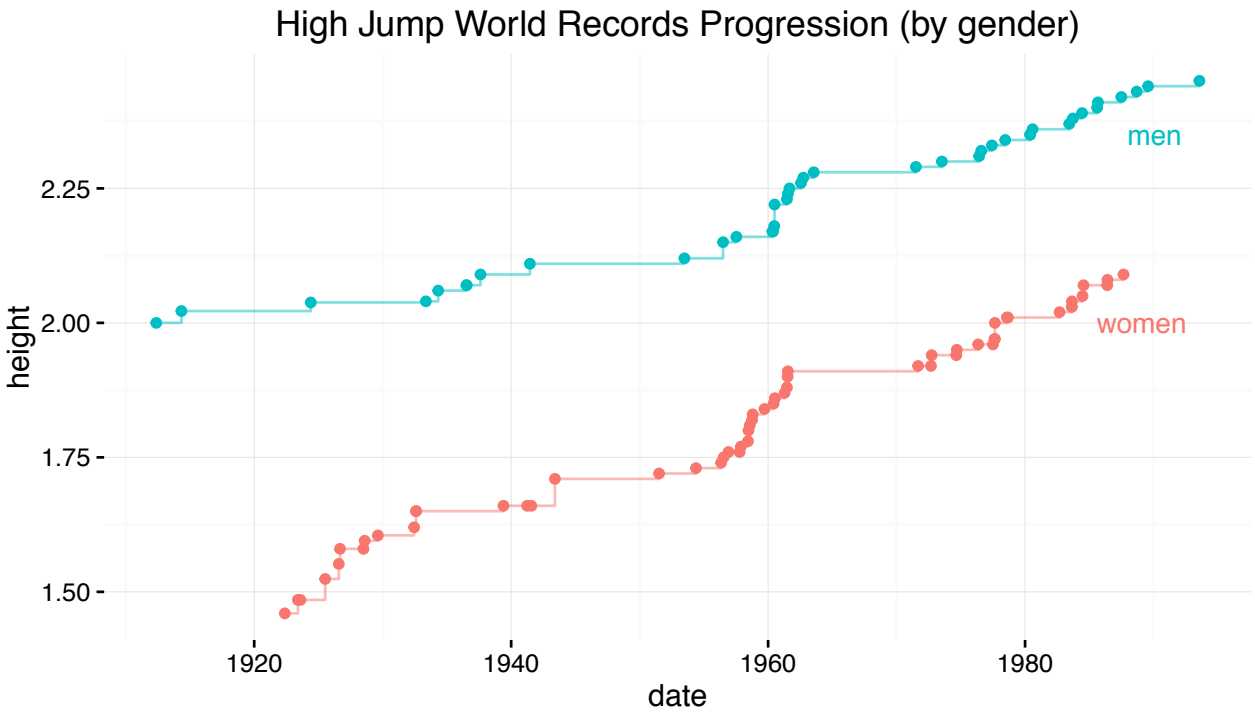
```
'data.frame':   96 obs. of  9 variables:
 $ height : num  1.46 ...
 $ athlete: chr  "Nancy Voorhees" ...
 $ gender : Factor w/ 2 levels "female","male": 1 1 ...
 $ country: chr  "USA" ...
 $ city   : chr  "Simsbury" ...
```

```
$ date    : Date, format: "1922-05-20" ...
$ day     : num  20 26 ...
$ month   : chr  "May" ...
$ year    : num  1922 ...
```

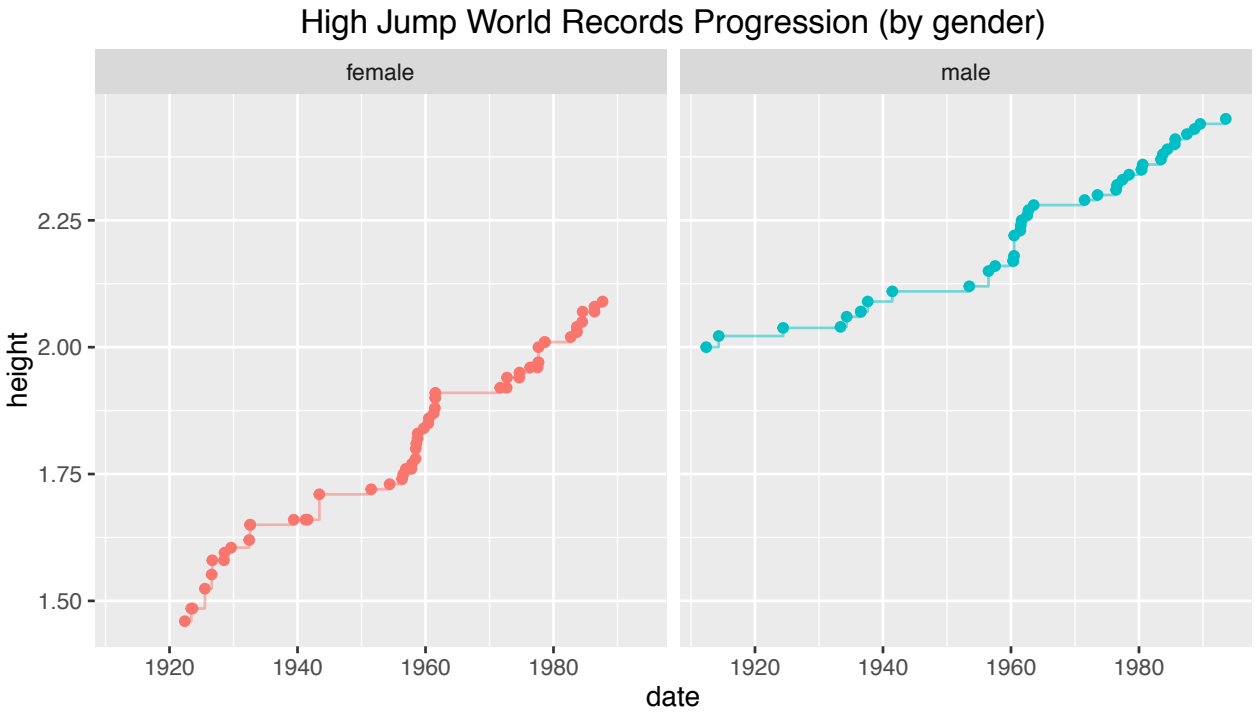
Data Visualization

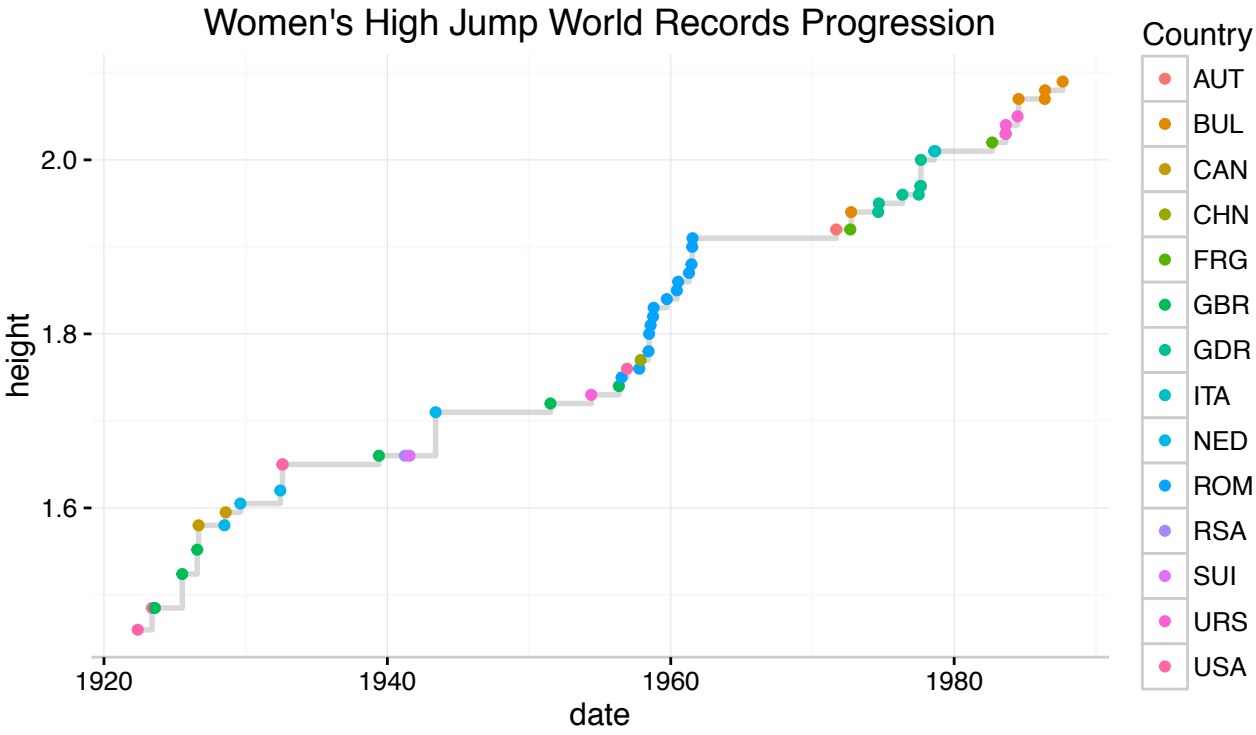
Your plots should look like the charts shown below one.

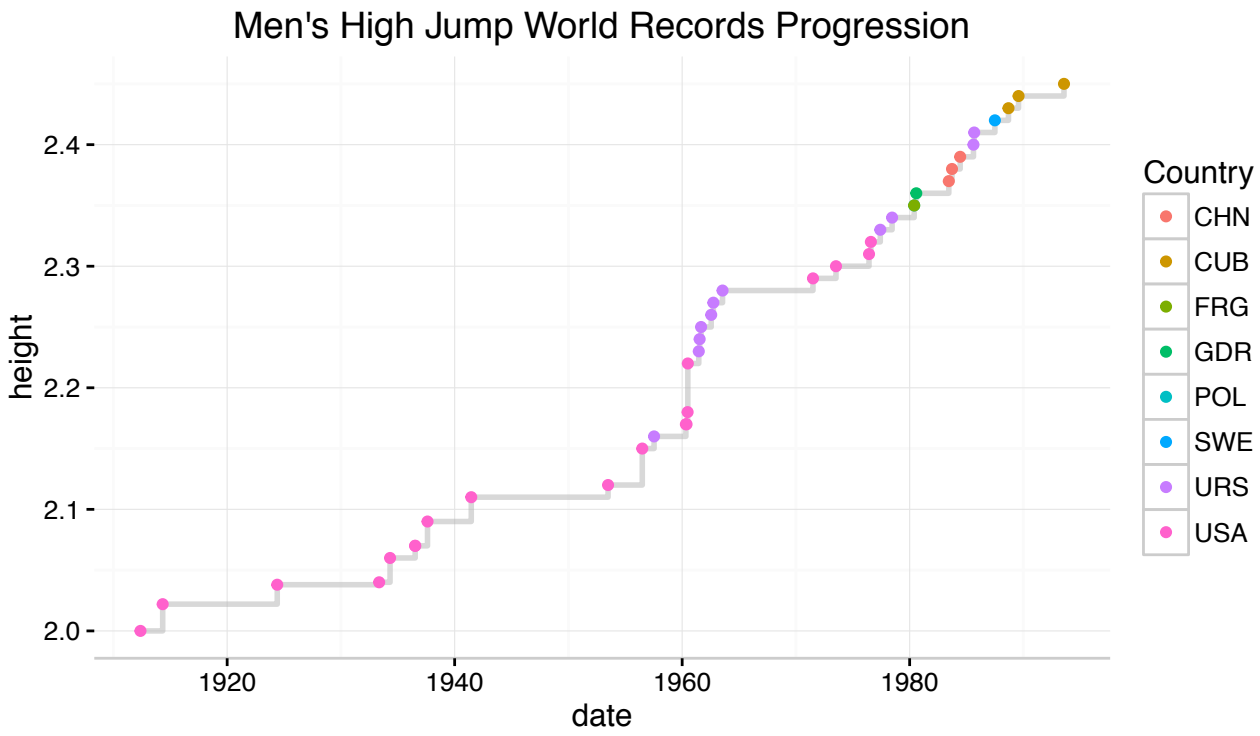
High Jump World Records Progression (by gender) version 1



High Jump World Records Progression (by gender) version 2






Men's High Jump World Records Progression
height
2.4
2.3
2.2
2.1
2.0
1920
1940
1960
1980
date
Country
CHN
CUB
FRG
GDR
POL
SWE
URS
USA