

PHW251 Problem Set 2

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Submission process: Please submit your assignment directly to Gradescope. You can do this by rendering your file and downloading the PDF to your computer. Then navigate to [Gradescope.com](https://www.gradescope.com) or via the link on BCourses to submit your assignment.

Helpful hints:

- Render your file early and often to minimize rendering errors! If you copy and paste code from the slides, you are bound to get an error that is hard to diagnose. Typing out the code is the way to smooth rendering. We recommend rendering your file each time after you write a few sentences/add a new code chunk, so you can detect the source of the rendering error more easily. You can render by clicking the blue “Render” arrow in the top menu bar in R studio. This will save you and the teaching team time!
- To render as PDF, you will need to have LaTeX installed. If you are using the datahub **this should already be there and you don’t need to install or update**. If you are not using datahub, there is an R package to handle this! If you don’t have LaTeX, you can un-comment and run the following code (note: you only need to do this once, and don’t need to load this like other packages).

```
# If you don't have LaTeX installed at all,  
# uncomment and run the line below  
# install.packages("tinytex")  
  
# If you need to update LaTeX or run into rendering issues,  
# uncomment and run the line below  
#tinytex::reinstall_tinytex()
```

- Please make sure that your code does not run off the page of the rendered PDF. If it does, we can’t see your work. To avoid this, have a look at your rendered PDF and ensure all the code fits in the file. When it doesn’t, go back to your .qmd file and add spaces (new lines) using the return or enter key so that the code runs onto the next line.

Question 1

Use the function `Sys.Date()` to get the current date. Save it in your environment.

```
today <- Sys.Date()
```

Use the `class()` function to see what kind of object your date is, and then use the `typeof()` function to see how it is stored in R.

```
class(today)
```

```
[1] "Date"
```

```
typeof(today)
```

```
[1] "double"
```

```
as.numeric(today)
```

```
[1] 20343
```

Why is your saved object both a Date and a double? HINT: try using `as.numeric()` on the object and think about what that number means.

R stores dates as the number of days since Jan 1, 1970. The double is the digit, and the class is how R presents the object, as a date

Dates in R are stored as the number of days before or after 1/1/1970, which is just a number (an integer stored as a double). Because the number came from `Sys.Date()`, R knows it is not just a normal number and instead displays it as a date.

Look up the documentation for the lubridate function `wday` (short for weekday). Load the lubridate library and then pass your date object to `wday()` to get the day of the week *as an abbreviated name* e.g. “Sun” and “Mon”. You will need to pass the function a second argument to make this happen. Save the result in your environment.

```
library(lubridate)
```

```
Attaching package: 'lubridate'
```

The following objects are masked from 'package:base':

date, intersect, setdiff, union

```
?wday  
wday(today)
```

```
[1] 6
```

```
abbr_today <- wday(today, label = TRUE)  
abbr_today
```

```
[1] Fri  
Levels: Sun < Mon < Tue < Wed < Thu < Fri < Sat
```

Run this code chunk to save a vector of the seven days of the week. The `levels()` function returns a vector containing the names of all the levels of a factor.

```
days <- levels(wday(Sys.Date(), label = TRUE))
```

Subset the vector of days to get a vector of *weekdays only* (Mon-Fri). You can pull out values from a vector by using a sequence of positions/indexes inside square brackets (see the lecture “Data Types and Objects in R”). Save the list of weekdays as a new object in your environment.

```
MtoF <- days[2:6]
```

Is the current day you saved in the `current_wday` chunk above a weekday? Check using the `%in%` operator. Also check if the current day is in the days vector.

```
abbr_today %in% MtoF
```

```
[1] TRUE
```

```
abbr_today %in% days
```

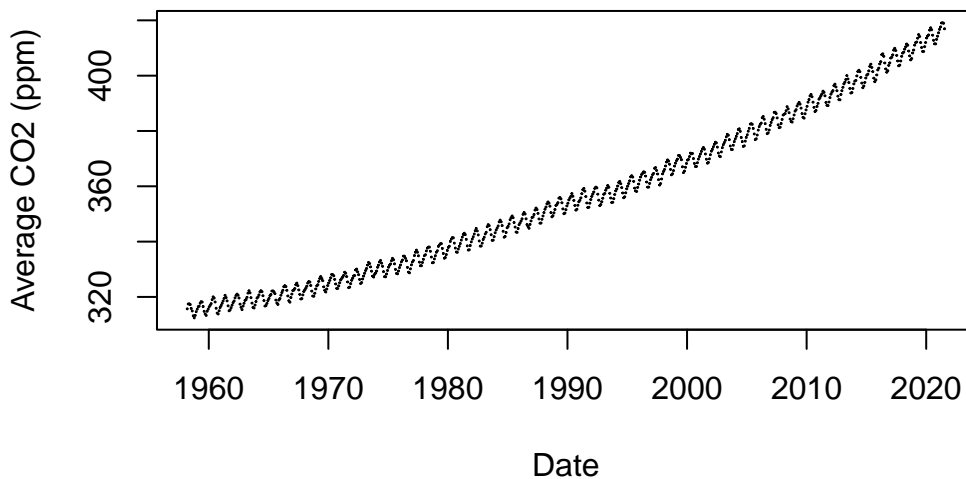
```
[1] TRUE
```

Question 2

if/else, vector math, logical ops

Run this chunk as-is to load a dataset of [Mauna Loa carbon dioxide records](#) and plot CO2 levels over time. Importing and plotting data will be covered in an upcoming lecture—the graph is just for context.

```
# read in the csv file and save it as a data frame in the environment
co2 <- read.csv(file = "co2_mm_mlo.csv", skip = 51, header = TRUE, row.names = NULL)
# label the columns
colnames(co2) <- c("year", "month", "date", "average", "interpolated", "trend", "ndays")
# display the data graphically
plot(x = co2$date, y = co2$average, pch = 20, cex = 0.1,
     xlab = "Date", ylab = "Average CO2 (ppm)")
```



```
# view the last few rows of the data in a table
tail(co2)
```

	year	month	date	average	interpolated	trend	ndays	NA
756	2021	2	2021.125	416.75	415.93	28	1.02	0.37
757	2021	3	2021.208	417.64	416.14	28	0.86	0.31
758	2021	4	2021.292	419.05	416.23	24	1.12	0.44

759	2021	5	2021.375	419.13	415.71	28	0.90	0.33
760	2021	6	2021.458	418.94	416.58	28	0.65	0.23
761	2021	7	2021.542	416.96	416.58	30	0.72	0.25

Before the industrial revolution, the global concentration of carbon dioxide was about [280 parts per million](#). Let's see if we can express CO2 levels over time as a percentage of pre-industrial levels.

Start by extracting the average CO2 level column from the data frame. You can run this chunk as-is, since we haven't covered data frames in detail yet.

```
# pull the "average" column out of the data as a vector
avg_co2 <- co2$average
# this is another way to do the exact same thing
avg_co2 <- co2[["average"]]
```

Print out the vector avg_co2

```
avg_co2
```

```
[1] 315.70 317.45 317.51 317.24 315.86 314.93 313.20 312.43 313.33 314.67
[11] 315.58 316.48 316.65 317.72 318.29 318.15 316.54 314.80 313.84 313.33
[21] 314.81 315.58 316.43 316.98 317.58 319.03 320.04 319.59 318.18 315.90
[31] 314.17 313.83 315.00 316.19 316.89 317.70 318.54 319.48 320.58 319.77
[41] 318.57 316.79 314.99 315.31 316.10 317.01 317.94 318.55 319.68 320.57
[51] 321.02 320.62 319.61 317.40 316.25 315.42 316.69 317.70 318.74 319.07
[61] 319.86 321.38 322.25 321.48 319.74 317.77 316.21 315.99 317.07 318.35
[71] 319.57 320.01 320.74 321.84 322.26 321.89 320.44 318.69 316.70 316.87
[81] 317.68 318.71 319.44 320.44 320.89 322.14 322.17 321.87 321.21 318.87
[91] 317.81 317.30 318.87 319.42 320.62 321.60 322.39 323.70 324.08 323.75
[101] 322.38 320.36 318.64 318.10 319.78 321.03 322.33 322.50 323.04 324.42
[111] 325.00 324.09 322.54 320.92 319.25 319.39 320.73 321.96 322.57 323.15
[121] 323.89 325.02 325.57 325.36 324.14 322.11 320.33 320.25 321.32 322.89
[131] 324.00 324.42 325.63 326.66 327.38 326.71 325.88 323.66 322.38 321.78
[141] 322.86 324.12 325.06 325.98 326.93 328.13 328.08 327.67 326.34 324.69
[151] 323.10 323.06 324.01 325.13 326.17 326.68 327.17 327.79 328.93 328.57
[161] 327.36 325.43 323.36 323.56 324.80 326.01 326.77 327.63 327.75 329.72
[171] 330.07 329.09 328.04 326.32 324.84 325.20 326.50 327.55 328.55 329.56
[181] 330.30 331.50 332.48 332.07 330.87 329.31 327.51 327.18 328.16 328.64
[191] 329.35 330.71 331.48 332.65 333.19 332.20 331.07 329.15 327.33 327.28
[201] 328.31 329.58 330.73 331.46 331.94 333.11 333.95 333.42 331.97 329.95
[211] 328.50 328.36 329.38 330.62 331.56 332.74 333.36 334.74 334.72 333.98
```

[221]	333.08	330.68	328.96	328.72	330.16	331.62	332.68	333.17	334.96	336.14
[231]	336.93	336.17	334.88	332.56	331.29	331.28	332.46	333.60	334.94	335.26
[241]	336.66	337.69	338.02	338.01	336.50	334.42	332.36	332.45	333.76	334.91
[251]	336.14	336.69	338.27	338.82	339.24	339.26	337.54	335.72	333.98	334.24
[261]	335.32	336.81	337.90	338.34	340.07	340.93	341.45	341.36	339.45	337.67
[271]	336.25	336.14	337.30	338.29	339.29	340.55	341.63	342.60	343.04	342.54
[281]	340.82	338.48	336.95	337.05	338.58	339.91	340.93	341.76	342.78	343.96
[291]	344.77	343.88	342.42	340.24	338.38	338.41	339.44	340.78	341.57	342.78
[301]	343.37	345.40	346.14	345.76	344.32	342.50	340.46	340.53	341.79	343.20
[311]	344.21	344.92	345.68	347.14	347.78	347.16	345.79	343.74	341.59	341.86
[321]	343.31	345.00	345.48	346.41	347.91	348.66	349.28	348.65	346.90	345.26
[331]	343.47	343.35	344.73	346.12	346.78	347.48	348.25	349.86	350.52	349.98
[341]	348.25	346.17	345.48	344.82	346.22	347.48	348.73	348.92	349.81	351.40
[351]	352.15	351.59	350.21	348.20	346.66	346.72	348.08	349.28	350.51	351.70
[361]	352.50	353.67	354.35	353.88	352.80	350.49	348.97	349.37	350.42	351.62
[371]	353.07	353.43	354.08	355.72	355.95	355.44	354.05	351.84	350.09	350.33
[381]	351.55	352.91	353.86	355.10	355.75	356.38	357.38	356.39	354.89	353.07
[391]	351.38	351.69	353.14	354.41	354.93	355.82	357.33	358.77	359.23	358.23
[401]	356.30	353.97	352.34	352.43	353.89	355.21	356.34	357.21	357.97	359.22
[411]	359.71	359.43	357.15	354.98	353.01	353.41	354.42	355.68	357.10	357.42
[421]	358.59	359.39	360.30	359.64	357.46	355.76	354.14	354.23	355.53	357.03
[431]	358.36	359.04	360.11	361.36	361.78	360.94	359.51	357.59	355.86	356.21
[441]	357.65	359.10	360.04	361.00	361.98	363.44	363.83	363.33	361.78	359.33
[451]	358.32	358.14	359.61	360.82	362.20	363.36	364.28	364.69	365.25	365.06
[461]	363.69	361.55	359.69	359.72	361.04	362.39	363.24	364.21	364.65	366.49
[471]	366.77	365.73	364.46	362.40	360.44	360.98	362.65	364.51	365.39	366.10
[481]	367.36	368.79	369.56	369.13	367.98	366.10	364.16	364.54	365.67	367.30
[491]	368.35	369.28	369.84	371.15	371.12	370.46	369.61	367.06	364.95	365.52
[501]	366.88	368.26	369.45	369.71	370.75	371.98	371.75	371.87	370.02	368.27
[511]	367.15	367.18	368.53	369.83	370.76	371.69	372.63	373.55	374.03	373.40
[521]	371.68	369.78	368.34	368.61	369.94	371.42	372.70	373.37	374.30	375.19
[531]	375.93	375.69	374.16	372.03	370.93	370.73	372.43	373.98	375.07	375.82
[541]	376.64	377.92	378.78	378.46	376.88	374.57	373.34	373.31	374.84	376.17
[551]	377.17	378.05	379.06	380.54	380.80	379.87	377.65	376.17	374.43	374.63
[561]	376.33	377.68	378.63	379.91	380.95	382.48	382.64	382.40	380.93	378.93
[571]	376.89	377.19	378.54	380.31	381.58	382.40	382.86	384.80	385.22	384.24
[581]	382.65	380.60	379.04	379.33	380.35	382.02	383.10	384.12	384.81	386.73
[591]	386.78	386.33	384.73	382.24	381.20	381.37	382.70	384.19	385.78	386.06
[601]	386.28	387.33	388.78	387.99	386.61	384.32	383.41	383.21	384.41	385.79
[611]	387.17	387.70	389.04	389.76	390.36	389.70	388.25	386.29	384.95	384.64
[621]	386.23	387.63	388.91	390.41	391.37	392.67	393.21	392.38	390.41	388.54
[631]	387.03	387.43	388.87	389.99	391.50	392.05	392.80	393.44	394.41	393.95
[641]	392.72	390.33	389.28	389.19	390.48	392.06	393.31	394.04	394.59	396.38

```
[651] 396.93 395.91 394.56 392.59 391.32 391.27 393.20 394.57 395.78 397.03
[661] 397.66 398.64 400.02 398.81 397.51 395.39 393.72 393.90 395.36 397.03
[671] 398.04 398.27 399.91 401.51 401.96 401.43 399.38 397.32 395.64 396.29
[681] 397.55 399.15 400.18 400.55 401.74 403.35 404.15 402.97 401.46 399.11
[691] 397.82 398.49 400.27 402.06 402.73 404.25 405.06 407.60 407.90 406.99
[701] 404.59 402.45 401.23 401.79 403.72 404.64 406.36 406.66 407.53 409.22
[711] 409.89 409.08 407.33 405.32 403.57 403.82 405.31 407.00 408.15 408.52
[721] 409.59 410.45 411.44 410.99 408.90 407.16 405.71 406.19 408.21 409.27
[731] 411.03 411.96 412.18 413.54 414.86 414.16 411.97 410.18 408.76 408.75
[741] 410.48 411.98 413.61 414.34 414.74 416.45 417.31 416.60 414.62 412.78
[751] 411.52 411.51 413.12 414.26 415.52 416.75 417.64 419.05 419.13 418.94
[761] 416.96
```

That's a lot of numbers! You wouldn't want to print all that in a report. Use the `summary()` function to get a more useful overview of the range of numbers in that vector.

```
summary(avg_co2)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 312.4   329.4   353.4   356.4   380.5   419.1
```

Create a vector that expresses the Mauna Loa CO2 levels as a percentage of pre-industrial levels (280 ppm). Save it as a new vector in your environment and print out a summary.

```
co2_per <- (avg_co2/280)*100
```

```
summary(co2_per)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 111.6   117.6   126.2   127.3   135.9   149.7
```

Let's say you're publishing a report about climate change and you want to have two versions of it for two different audiences. In one version, you want to report carbon dioxide concentration in parts per million. In the other, you want those numbers as a percentage of pre-industrial levels.

Use if/else blocks to print a summary of Mauna Loa CO2 levels, where the format (ppm or percentage) depends on the logical indicator included in the code chunk below. Make sure you get the expected output when percentage is TRUE, and when percentage is FALSE.

```
percentage <- TRUE

if (percentage) {
  print(summary(co2_per))
} else {
  print(summary(avg_co2))
}
```

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
111.6	117.6	126.2	127.3	135.9	149.7

Look at the date columns in the co2 data frame (you can view the whole table by clicking on “co2” in your environment pane). The “date” column is in a decimal date format. Search the web for a function within the lubridate package that can convert a decimal date into the standard date format. Use that function on the vector of decimal dates and print the result. Make sure you set the correct time zone for Hawaii (search the web for the 3-letter abbreviation of that time zone and use that string as the argument)!

```
co2$date
```

```
[1] 1958.203 1958.288 1958.370 1958.455 1958.537 1958.622 1958.707 1958.789
[9] 1958.874 1958.956 1959.041 1959.126 1959.203 1959.288 1959.370 1959.455
[17] 1959.537 1959.622 1959.707 1959.789 1959.874 1959.956 1960.041 1960.126
[25] 1960.205 1960.290 1960.372 1960.456 1960.538 1960.623 1960.708 1960.790
[33] 1960.874 1960.956 1961.041 1961.126 1961.203 1961.288 1961.370 1961.455
[41] 1961.537 1961.622 1961.707 1961.789 1961.874 1961.956 1962.041 1962.126
[49] 1962.203 1962.288 1962.370 1962.455 1962.537 1962.622 1962.707 1962.789
[57] 1962.874 1962.956 1963.041 1963.126 1963.203 1963.288 1963.370 1963.455
[65] 1963.537 1963.622 1963.707 1963.789 1963.874 1963.956 1964.041 1964.126
[73] 1964.205 1964.290 1964.372 1964.456 1964.538 1964.623 1964.708 1964.790
[81] 1964.874 1964.956 1965.041 1965.126 1965.203 1965.288 1965.370 1965.455
[89] 1965.537 1965.622 1965.707 1965.789 1965.874 1965.956 1966.041 1966.126
[97] 1966.203 1966.288 1966.370 1966.455 1966.537 1966.622 1966.707 1966.789
[105] 1966.874 1966.956 1967.041 1967.126 1967.203 1967.288 1967.370 1967.455
[113] 1967.537 1967.622 1967.707 1967.789 1967.874 1967.956 1968.041 1968.126
[121] 1968.205 1968.290 1968.372 1968.456 1968.538 1968.623 1968.708 1968.790
[129] 1968.874 1968.956 1969.041 1969.126 1969.203 1969.288 1969.370 1969.455
[137] 1969.537 1969.622 1969.707 1969.789 1969.874 1969.956 1970.041 1970.126
[145] 1970.203 1970.288 1970.370 1970.455 1970.537 1970.622 1970.707 1970.789
[153] 1970.874 1970.956 1971.041 1971.126 1971.203 1971.288 1971.370 1971.455
[161] 1971.537 1971.622 1971.707 1971.789 1971.874 1971.956 1972.041 1972.126
```


[169]	1972.205	1972.290	1972.372	1972.456	1972.538	1972.623	1972.708	1972.790
[177]	1972.874	1972.956	1973.041	1973.126	1973.203	1973.288	1973.370	1973.455
[185]	1973.537	1973.622	1973.707	1973.789	1973.874	1973.956	1974.041	1974.126
[193]	1974.203	1974.288	1974.375	1974.458	1974.542	1974.625	1974.708	1974.792
[201]	1974.875	1974.958	1975.042	1975.125	1975.208	1975.292	1975.375	1975.458
[209]	1975.542	1975.625	1975.708	1975.792	1975.875	1975.958	1976.042	1976.125
[217]	1976.208	1976.292	1976.375	1976.458	1976.542	1976.625	1976.708	1976.792
[225]	1976.875	1976.958	1977.042	1977.125	1977.208	1977.292	1977.375	1977.458
[233]	1977.542	1977.625	1977.708	1977.792	1977.875	1977.958	1978.042	1978.125
[241]	1978.208	1978.292	1978.375	1978.458	1978.542	1978.625	1978.708	1978.792
[249]	1978.875	1978.958	1979.042	1979.125	1979.208	1979.292	1979.375	1979.458
[257]	1979.542	1979.625	1979.708	1979.792	1979.875	1979.958	1980.042	1980.125
[265]	1980.208	1980.292	1980.375	1980.458	1980.542	1980.625	1980.708	1980.792
[273]	1980.875	1980.958	1981.042	1981.125	1981.208	1981.292	1981.375	1981.458
[281]	1981.542	1981.625	1981.708	1981.792	1981.875	1981.958	1982.042	1982.125
[289]	1982.208	1982.292	1982.375	1982.458	1982.542	1982.625	1982.708	1982.792
[297]	1982.875	1982.958	1983.042	1983.125	1983.208	1983.292	1983.375	1983.458
[305]	1983.542	1983.625	1983.708	1983.792	1983.875	1983.958	1984.042	1984.125
[313]	1984.208	1984.292	1984.375	1984.458	1984.542	1984.625	1984.708	1984.792
[321]	1984.875	1984.958	1985.042	1985.125	1985.208	1985.292	1985.375	1985.458
[329]	1985.542	1985.625	1985.708	1985.792	1985.875	1985.958	1986.042	1986.125
[337]	1986.208	1986.292	1986.375	1986.458	1986.542	1986.625	1986.708	1986.792
[345]	1986.875	1986.958	1987.042	1987.125	1987.208	1987.292	1987.375	1987.458
[353]	1987.542	1987.625	1987.708	1987.792	1987.875	1987.958	1988.042	1988.125
[361]	1988.208	1988.292	1988.375	1988.458	1988.542	1988.625	1988.708	1988.792
[369]	1988.875	1988.958	1989.042	1989.125	1989.208	1989.292	1989.375	1989.458
[377]	1989.542	1989.625	1989.708	1989.792	1989.875	1989.958	1990.042	1990.125
[385]	1990.208	1990.292	1990.375	1990.458	1990.542	1990.625	1990.708	1990.792
[393]	1990.875	1990.958	1991.042	1991.125	1991.208	1991.292	1991.375	1991.458
[401]	1991.542	1991.625	1991.708	1991.792	1991.875	1991.958	1992.042	1992.125
[409]	1992.208	1992.292	1992.375	1992.458	1992.542	1992.625	1992.708	1992.792
[417]	1992.875	1992.958	1993.042	1993.125	1993.208	1993.292	1993.375	1993.458
[425]	1993.542	1993.625	1993.708	1993.792	1993.875	1993.958	1994.042	1994.125
[433]	1994.208	1994.292	1994.375	1994.458	1994.542	1994.625	1994.708	1994.792
[441]	1994.875	1994.958	1995.042	1995.125	1995.208	1995.292	1995.375	1995.458
[449]	1995.542	1995.625	1995.708	1995.792	1995.875	1995.958	1996.042	1996.125
[457]	1996.208	1996.292	1996.375	1996.458	1996.542	1996.625	1996.708	1996.792
[465]	1996.875	1996.958	1997.042	1997.125	1997.208	1997.292	1997.375	1997.458
[473]	1997.542	1997.625	1997.708	1997.792	1997.875	1997.958	1998.042	1998.125
[481]	1998.208	1998.292	1998.375	1998.458	1998.542	1998.625	1998.708	1998.792
[489]	1998.875	1998.958	1999.042	1999.125	1999.208	1999.292	1999.375	1999.458
[497]	1999.542	1999.625	1999.708	1999.792	1999.875	1999.958	2000.042	2000.125
[505]	2000.208	2000.292	2000.375	2000.458	2000.542	2000.625	2000.708	2000.792

```

[513] 2000.875 2000.958 2001.042 2001.125 2001.208 2001.292 2001.375 2001.458
[521] 2001.542 2001.625 2001.708 2001.792 2001.875 2001.958 2002.042 2002.125
[529] 2002.208 2002.292 2002.375 2002.458 2002.542 2002.625 2002.708 2002.792
[537] 2002.875 2002.958 2003.042 2003.125 2003.208 2003.292 2003.375 2003.458
[545] 2003.542 2003.625 2003.708 2003.792 2003.875 2003.958 2004.042 2004.125
[553] 2004.208 2004.292 2004.375 2004.458 2004.542 2004.625 2004.708 2004.792
[561] 2004.875 2004.958 2005.042 2005.125 2005.208 2005.292 2005.375 2005.458
[569] 2005.542 2005.625 2005.708 2005.792 2005.875 2005.958 2006.042 2006.125
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[761] "2021-07-17 17:17:31 HST"

```

Question 3

Use a for loop to print out the result of multiplying the numbers 1-10 by 3.

```

for (i in 1:10) {
  print(i * 3)
}

```

```

[1] 3
[1] 6

```

[1] 9
[1] 12
[1] 15
[1] 18
[1] 21
[1] 24
[1] 27
[1] 30

Question 4

Use a while loop to do the same thing. It's easy to accidentally create infinite loops; if your chunk takes more than a couple seconds to run, press the red square in the top right corner of the chunk to abort the loop.

```
i <- 1
while (i <= 10) {
  print(i * 3)
  i <- i + 1
}
```

```
[1] 3
[1] 6
[1] 9
[1] 12
[1] 15
[1] 18
[1] 21
[1] 24
[1] 27
[1] 30
```

Question 5

If you haven't created a GitHub account yet, do it now. Paste a link to your GitHub profile below:

<https://github.com/nilsonpalma/PHW251.git>

Question 6

You're working on a group coding project with your classmates that's due soon. After a weekend away from your computer, you open R Studio to start working. What is the first git command you should run?

git Pull

Question 7

You write some new code, save your Qmd file, commit your changes to your local repository, and then go eat dinner. While you're eating, your teammate sends you a message asking where your new code is. What did you forget to do?

git Push

You're done! Please render to pdf and upload to Gradescope.