Summary

2017-03-21

```r
library(lifelogr)
```

Lifelogging is the "process of tracking personal data generated by our own behavioral activities." Examples of lifelogging include tracking one's exercise and sleep. While devices like iPhones and fitbits make collecting data on oneself easy, analyzing and interpreting that data is more difficult.

The lifelogr package makes life logging analysis and interpretation easy by:

- Creating three sets of visualizations
- Creating an experimentation framework

This package was designed to work with fitbit data, but users can also provide their own data. However, with the exception of Apple data, the data types and names must match those provided here for lifelogr's functions to work.

Data

This package is built around the Person class, an R6 class. Users can create instances of the Person class by providing information about themselves and either their data directly or access to their data.

Fitbit users can provide their username and password. Fitbit allows login via Facebook and Google, but this library only works with fitbit login.

```r
EX <- Person$new(fitbit_user_email = "example@domain.com",
                 fitbit_user_pw = "password",
                 apple_data_file = "apple.csv",
                 addl_data = NA,
                 user_info = list("name" = "EX", "age" = 29, "gender" = "male"),
                 target_steps = 10000,
                 group_assignments = list(data.frame(NA), data.frame(NA)),
                 start_date = "2017-01-19", end_date = "2017-02-17")
```

iPhone users can provide their Apple data as a csv. There is an iOS app called QS Access (quantified self) where you can select which measures you would like and on which time scale (by day or by hour), and it will create a csv file for you. For greater compatibility with the lifelogr package, users are highly recommended to select the "by hour" time interval.

Users can provide other sources of data as a data frame, as an argument to `addl_data` or `addl_data2`.

EX is an instance of the Person class, which has 3 main public data frames:

- `fitbit_daily` has fitbit data recorded on a daily basis
- `fitbit_intraday`, has fitbit data recorded on an intraday basis, generally every 15 minutes, although for certain variables, such as heart rate, data are recorded every 5 minutes.
- `fitbit_util`, which has information about the dates in the range specified by the user when creating the Person instantiation, such as day of week and month.

Dates, Times, and Date-Times

Dates and times come in numerous forms. lifelogr uses three primary types of dates/times:

- date: "2017-03-20"

- time: “08:00:00”
- datetime: “2017-03-20 08:00:00”, a combination of a date and a time

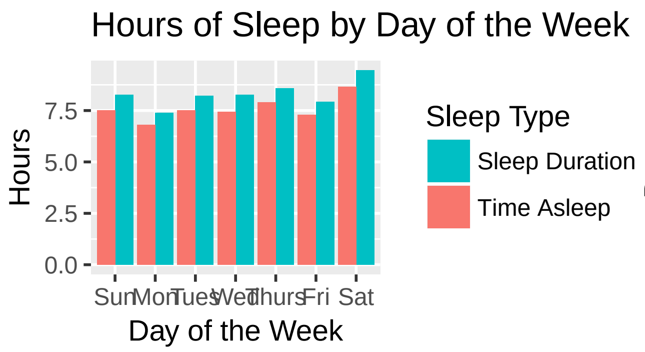
Visualization

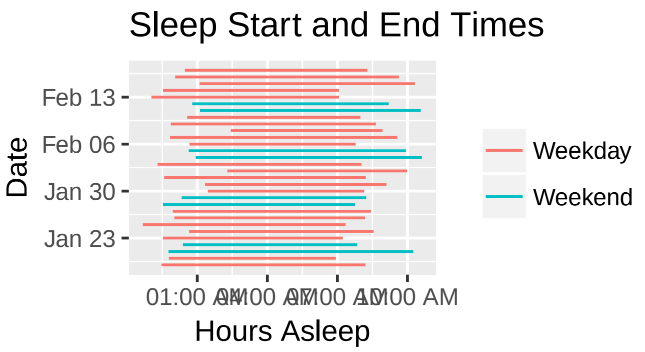
There are 3 functions which allow for a series of plots with just one function call: `plot_sleep_all`, `plot_daily_all`, and `plot_intraday_all`. Each acts like the `plot.lm` function, where users must click “enter” to see the next plot.

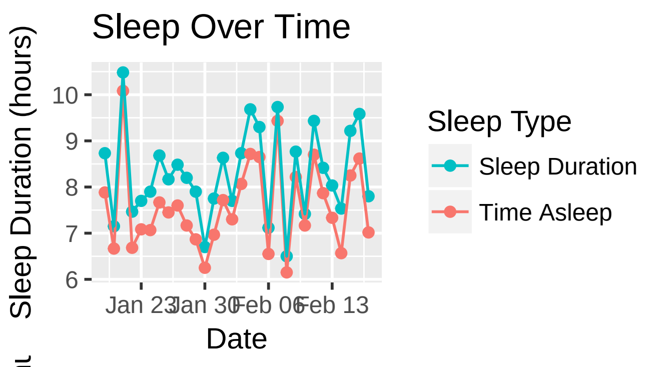
Each plot within the generic plot function can also be called individually.

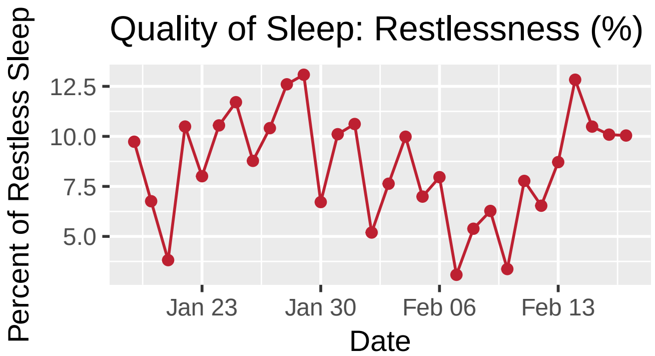
For example, using `plot_sleep_all` to generate all the sleep plots for EX:

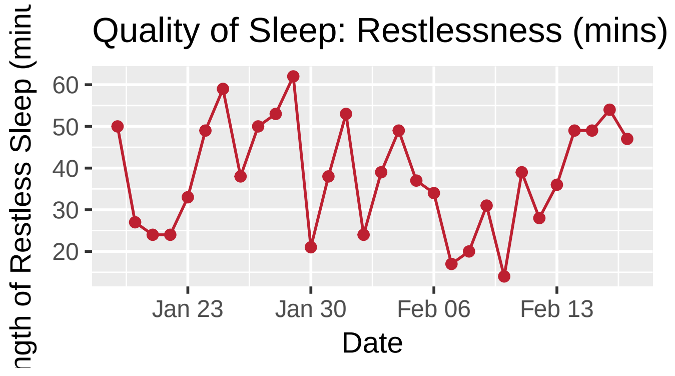
```
plot_sleep_all(EX)
#> Press [enter] to continue
#> Press [enter] to continue
#> Press [enter] to continue
#> Press [enter] to continue
#> Press [enter] to continue
#> Press [enter] to continue
```

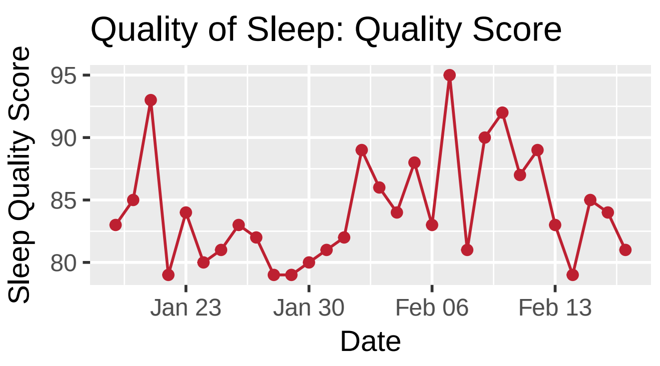










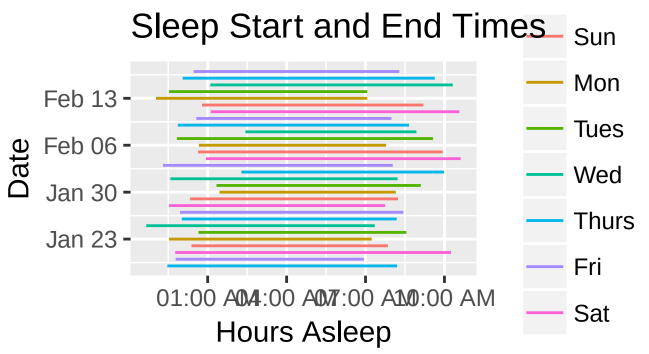


Calling `plot_daily_all` and `plot_intraday_all` will result in similar series of plots.

Users can also call each function individually using `plot_sleep(person, plot_type)` (or `plot_daily` or `plot_intraday`), and also pass in other arguments for plots with other arguments.

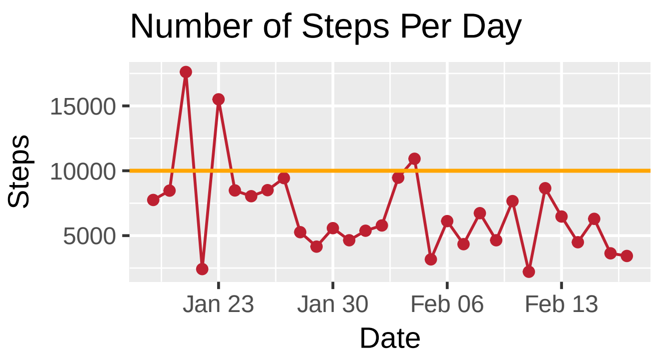
For example:

```r
plot_sleep(EX, "by_start_end_time", "day_of_week")
```



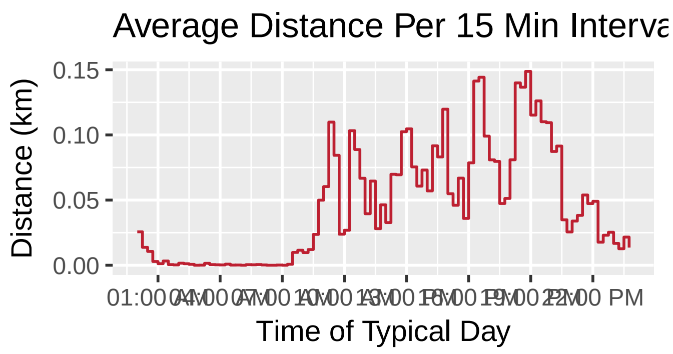
Using `plot_daily`:

```r
plot_daily(EX, "steps")
```



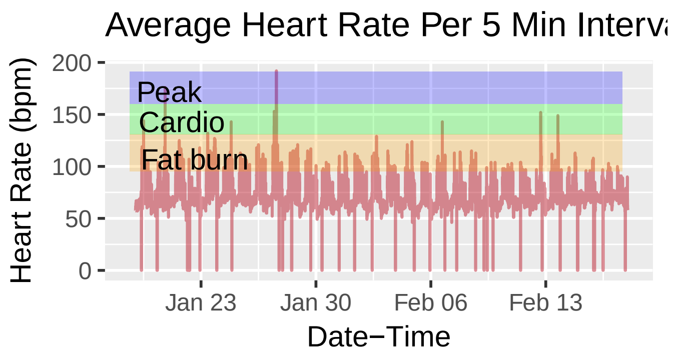
Using `plot_intraday`: The default is for `plot_intraday` to aggregate the data by time intervals within each day so that data for a “typical day” is displayed.

```r
plot_intraday(EX, "distance", unit = "km")
```



However, it is also possible to specify that the plots use the raw data and plot over all datetimes.

```r
plot_intraday(EX, "bpm", FALSE)
```



Experimentation Framework

While almost all the visualizations shown above had date, date-time, or time on the x axis, the experimentation framework allows for greater flexibility. Users can select any variables of interest and examine their relationship.

Users can specify * x variables of interest * y measures of interest * type of analysis ("plot", "correlation", "anova", "compare_groups", or "regression") * time variable (date, time, or datetime)

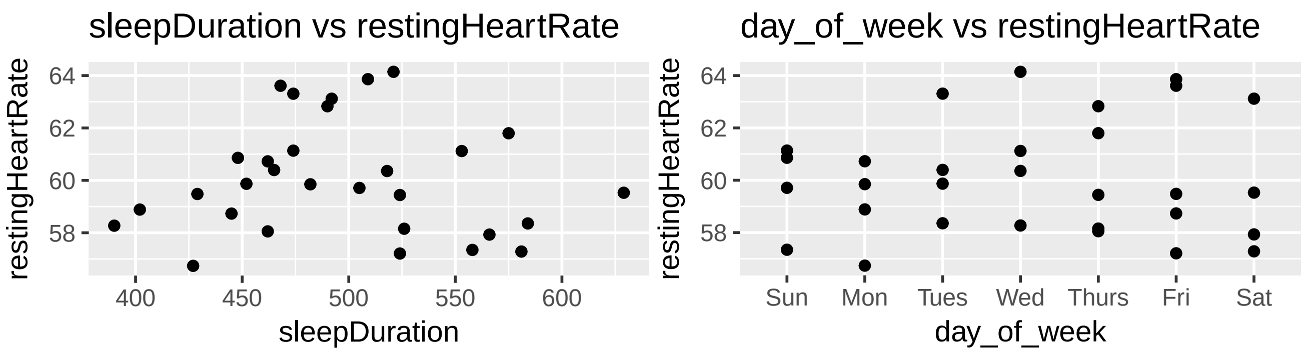
The `experiment` function will study every pairwise combination of the variable and measure variables given.

Each analysis can also be called using `l_plot`, `correlation`, `l_anova`, `compare_groups`, or `l_regression` instead of using `experiment`.

1. Plots

   To plot the relationship between sleep duration and resting heart rate and the relationship between day of week and resting heart rate on a date basis:

```
experiment(person = EX,
           variables = list("fitbit_daily" = c("sleepDuration"),
                            "util" = c("day_of_week")),
           measures = list("fitbit_daily" = c("restingHeartRate")),
           analysis = c("plot"),
           time_var = c("date"))
```



2. Correlation

   To calculate the correlation between sleep duration and number of steps on a date basis:

```
experiment(person = EX,
           variables = list("fitbit_daily" = c("sleepDuration")),
           measures = list("fitbit_intraday" = c("distance")),
           analysis = c("correlation"),
           time_var = c("date"))
#> [1] -0.01030084
```

l_plot will generate the same result:

```
    dataset <- create_dataset(person = EX,
                              all_variables = list("fitbit_daily" = c("sleepDuration"),
                                                   "fitbit_intraday" = c("distance")),
                              time_var = c("date"))

    correlation_df <- correlation(dataset, person = EX,
                                  variables = list("fitbit_daily" = c("sleepDuration")),
                                  measures = list("fitbit_intraday" = c("distance")),
                                  time_var = "date")
#> [1] -0.01030084
```

3. ANOVA

   To create ANOVAs for the effect of sleep duration and steps on resting heart rate on a date basis:

```
experiment(person = EX,
           variables = list("fitbit_daily" = c("sleepDuration", "steps")),
           measures = list("fitbit_daily" = c("restingHeartRate")),
           analysis = c("anova"),
           time_var = c("date"))
#> [1] "restingHeartRate ~ (sleepDuration + steps)^2"
#> Analysis of Variance Table
#>
#> Response: restingHeartRate
#>                     Df  Sum Sq Mean Sq F value Pr(>F)
#> sleepDuration        1   0.252  0.2525  0.0489 0.8266
#> steps                1   0.228  0.2277  0.0441 0.8352
#> sleepDuration:steps  1   0.203  0.2026  0.0393 0.8444
#> Residuals           26 134.102  5.1578
```

4. Compare Groups

   To compare across time variables not already defined, such as months, users can set up groups. Groups must be part of the Person instance, so it is oftentimes easier to just use compare_groups.

   In this case, only data from January and February is in the sample instance of Person, so only two groups are compared:

```
 dataset <- create_dataset(person = EX,
                       all_variables = list("util" = c("month"),
                                            "fitbit_daily" =
                                              c("sleepDuration",
                                                "steps",
                                                "restingHeartRate")),
                       time_var = c("date"))

indiv_months <- data.frame("month" = c("Jan", "Feb", "Mar", "Apr", "May",
                                       "Jun", "Jul", "Aug",
                                       "Sep", "Oct", "Nov", "Dec"),
                           "group" = c(1:12))

compare_groups(dataset, person = EX,
                     addl_grouping_assignments = list("indiv_months" =
                                                       indiv_months),
                     names_of_groupings = c("indiv_months"),
                     variables_to_compare = c("steps", "restingHeartRate"))
#> [1] "month"
#> [1] "steps"
#> # A tibble: 2 × 3
#>   group     mean       sd
#>   <int>    <dbl>    <dbl>
#> 1     1 8142.692 4300.470
#> 2     2 5847.412 2350.607
#> [1] "restingHeartRate"
#> # A tibble: 2 × 3
#>   group     mean       sd
#>   <int>    <dbl>    <dbl>
#> 1     1 61.36231 1.856939
#> 2     2 59.08167 1.855553
```

5. Regression

   To run a regression of resting heart rate on steps ˆ 2

```
experiment(person = EX,
               variables = list("fitbit_daily" = c("steps")),
               measures = list("fitbit_daily" = c("restingHeartRate")),
               analysis = c("regression"),
               time_var = c("date"))
#> [1] "restingHeartRate ~ (steps)^2"
#>
#> Call:
#> lm(formula = restingHeartRate ~ (steps)^2, data = dataset)
#>
#> Residuals:
#>     Min      1Q  Median      3Q     Max
#> -3.3178 -1.7636 -0.3039  1.1040  4.0493
#>
#> Coefficients:
#>              Estimate Std. Error t value Pr(>|t|)
#> (Intercept) 5.993e+01  8.972e-01  66.796   <2e-16 ***
#> steps       2.008e-05  1.174e-04   0.171    0.865
#> ---
#> Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
#>
#> Residual standard error: 2.193 on 28 degrees of freedom
#> Multiple R-squared:  0.001044,   Adjusted R-squared:  -0.03463
#> F-statistic: 0.02927 on 1 and 28 DF,  p-value: 0.8654
```

Shiny Application

Apple Data

Reflections

In our proposal, we explained that our package would accomplish 5 tasks:

1. Data matching
2. Visualization
3. Analysis
4. Recommendations
5. Experimentation

We had to scale back on our proposal, after discovering the complexity of fitbit data. We chose to create an R6 class to create Person objects representing each user. We built upon another package called fitbitScraper, which scrapes from fitbit's website. Functions from this package only pull portions of the data. We had to create functions to pull as much of the data as possible and join it together.

We successfully created functions allowing the user to easily visualize certain measures and run a series of experiments. We created a framework for users to add whatever additional data they want and then analyze it.

Future work can involve providing recommendations and the ability to visually compare measures. Creating recommendation functionality is difficult because it generally involves a human. A package can tell its user that his/her resting heart rate is too high or that s/he is not meeting his/her step count, but providing recommendations for how to solve that issue is more difficult. Fitbit does not claim to be a replacement for a doctor, and neither does this package.