Because, obviously, I am not going to make my son's actual weight data available on the internet, I created some mock data, similar to real-world examples (weight in *g*):

```
library(readr)
library(lubridate)

# download from https://github.com/ShirinG/who_baby_weight_app/
weight_measures <- read_delim("weight_measures.csv",
                              delim = ",",
                              col_types = list(col_date(format = "%d.%m.%Y"),
col_double()))
head(weight_measures)
```

```
## # A tibble: 6 x 2
##   date       weight
##
## 1 2019-08-12   3168
## 2 2019-08-16   3126
## 3 2019-08-17   3138
## 4 2019-08-18   3348
## 5 2019-08-20   3286
## 6 2019-08-22   3626
```

In the Baby Weight Shiny app, you can upload this mock data or your own data. Then choose:

- whether the columns in your `.csv` are separated by **comma, semicolon or tabulator**
- whether you want to show only reference values for the **first 13 weeks** or for the **first 5 years** (only reference values corresponding to your measurement dates will be shown)
- whether your weight data is given in **gramm or kilogramm** and
- whether you want to display reference data for **girls or boys**

You can then check to see if the data looks correct (tab: *Data*). The tabs *Curve* and *Barchart* show two plots. Below, I'll describe how I prepared the data for plotting.

Data preparation

First, I combined my weight measures with the reference tables from WHO. The function is saved in a script on Github for you to examine. The function code contains comments that describe what I've been doing. Here is the outcome:

```
library(tidyverse)

# download from https://github.com/ShirinG/who_baby_weight_app/
source("combine_measures.R")
p_0_5 <- read_csv("p_0_5.csv")
p_0_13 <- read_csv("p_0_13.csv")

combine_measures_who_final <- combine_measures_who(weight_measures,
                                                   p_0_13, p_0_5,
                                                   age_range = "0_5",
                                                   weight_in = "g",
                                                   gender = "boy")
head(combine_measures_who_final)
```

```
## # A tibble: 6 x 10
##   date       weight ref     percentile starting_p Month     L     M     S
gender
##
```

```
## 1 2019-08-12   3.17 measur… measureme… P50           NA    NA    NA    NA
## 2 2019-08-16   3.13 measur… measureme… P50           NA    NA    NA    NA
## 3 2019-08-17   3.14 measur… measureme… P50           NA    NA    NA    NA
## 4 2019-08-18   3.35 measur… measureme… P50           NA    NA    NA    NA
## 5 2019-08-20   3.29 measur… measureme… P50           NA    NA    NA    NA
## 6 2019-08-22   3.63 measur… measureme… P50           NA    NA    NA    NA
```

In order to calculate weight data for every full week of life (to make the values comparable with the reference), I am interpolating weight values for every day with missing information (linear approximation).

```
# add missing dates for calculating weight change per week of life
reference_date <- weight_measures$date[[1]]
end_date <- weight_measures$date[[nrow(weight_measures)]]

starting_p <- combine_measures_who_final %>%
  filter(date == reference_date) %>%
  select(starting_p) %>%
  .[[1]] %>%
  .[1]

all_dates <- seq(from = reference_date, to = end_date, by = "day") %>%
  as_tibble()
colnames(all_dates) = "date"

weight_measures_all <- weight_measures %>%
  full_join(all_dates, by = "date") %>%
  arrange(date)

## approximate missing values
weight_measures_all <- weight_measures_all %>%
  mutate(weight_approx = approx(weight, n = nrow(.))[[2]])

## add running week number
nos <- rep(1:ceiling(nrow(weight_measures_all)/7), each = 7)
weight_measures_all$week <- nos[1:nrow(weight_measures_all)]

## calculate sum over week
weight_measures_all <- weight_measures_all %>%
  mutate(diff_day = c(0, diff(weight_approx, lag = 1)),
         diff_week = c(rep(0, 7), diff(weight_approx, lag = 7)))
```

I also want to know the month of life, so I am using the following function to do so:

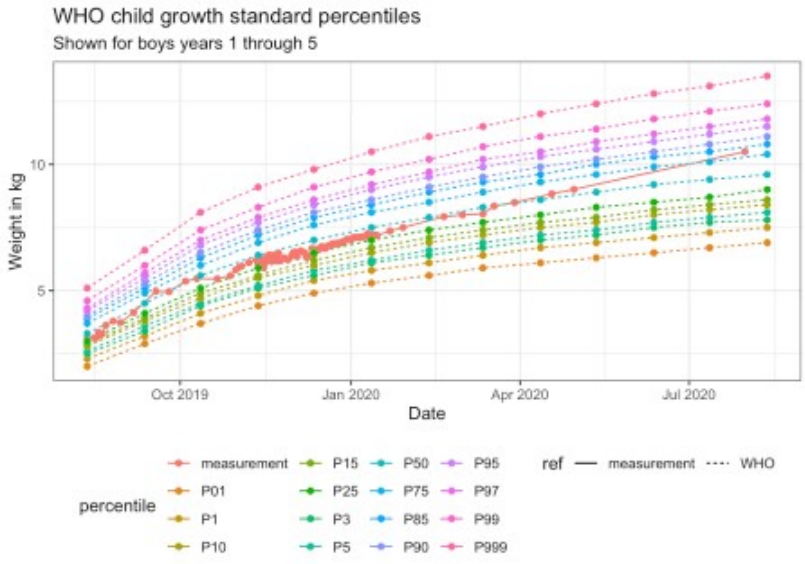
```
# download from https://github.com/ShirinG/who_baby_weight_app/
source("elapsed_months.R")
weight_measures_all <- weight_measures_all %>%
  mutate(month = elapsed_months(date, reference_date))
```

The curve

The first plot shows a simple lineplot with all reference curves (i.e. all WHO growth percentiles) and my measurements plotted against them. The plot in the Shiny app has been created with **Plotly**, so you can click on the legend to hide/show specific growth percentiles or zoom into specific areas on the plot.

```
gender <- "boys"
age <- "years 1 through 5"

combine_measures_who_final %>%
  ggplot(aes(date, weight,
```

```
            linetype = ref,
            color = percentile)) +
    geom_line() +
    geom_point() +
    labs(x = "Date",
         y = "Weight in kg",
         title = "WHO child growth standard percentiles",
         subtitle = paste("Shown for", gender, age)) +
    theme_bw() +
    theme(legend.position = "bottom")
```



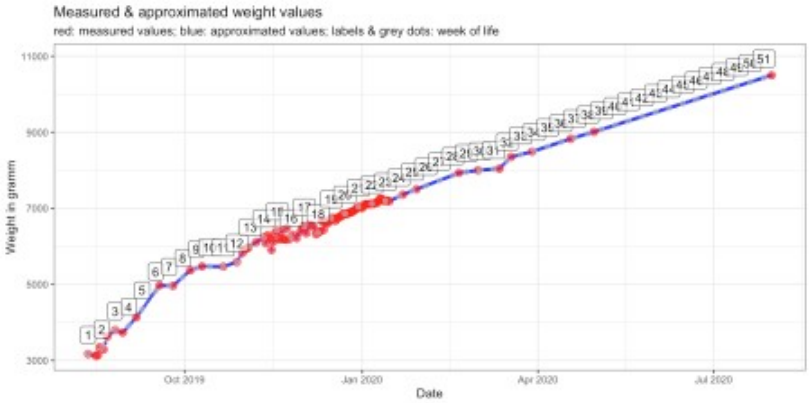

```
test_curves <- combine_measures_who_final %>%
  filter(percentile == !!paste(starting_p)) %>%
  left_join(select(weight_measures_all, date, weight_approx), by = "date")

paste("Your reference percentile is:", starting_p)

## [1] "Your reference percentile is: P50"

paste("Correlation between your measurements and your reference percentile is:",
      round(cor(test_curves$weight, test_curves$weight_approx, use =
'complete.obs'), digits = 5))

## [1] "Correlation between your measurements and your reference percentile is:
0.98757"
```

Approximated missing values

The next plot is not shown in the Shiny app, but here I'll include it to show how the interpolated weight values look like:

```
weight_measures_all %>%
  ggplot(aes(x = date)) +
    geom_line(aes(y = weight_approx), color = "grey") +
    geom_point(aes(y = weight_approx), color = "blue", size = 1, alpha = 0.6) +
    geom_point(aes(y = weight), color = "red", size = 3, alpha = 0.6) +
    geom_point(data = weight_measures_all %>% distinct(week, .keep_all = TRUE),
               aes(x = date, y = weight_approx),
               color = "grey", size = 2, alpha = 0.6) +
    geom_label(data = weight_measures_all %>% distinct(week, .keep_all = TRUE),
               aes(x = date, y = weight_approx, label = week),
               nudge_y = 500, alpha = 0.6) +
```

```
    labs(x = "Date",
         y = "Weight in gramm",
         title = "Measured & approximated weight values",
         subtitle = "red: measured values; blue: approximated values; labels &
grey dots: week of life") +
    theme_bw()
```



Barchart

The barchart, which you can find in the Shiny app, shows weekly weight differences, i.e. for every day the difference in weight compared to 7 days prior is calculated.

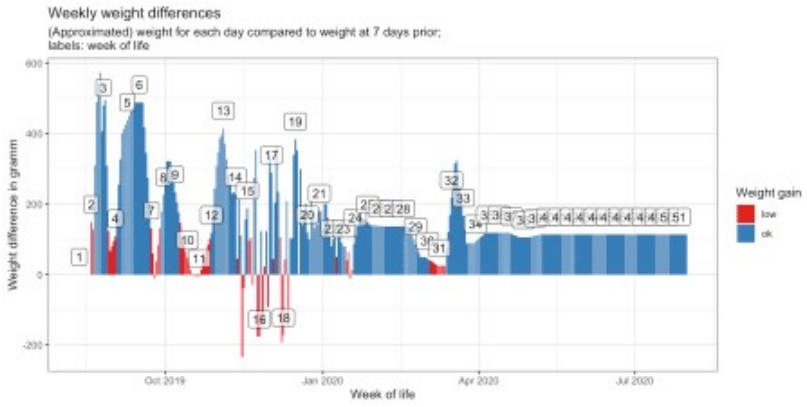
Bar colors show whether the weekly weight difference is above (blue) or below (red) the required minimum for **BREASTFED** babies given by this German site about breastfeeding:

- in months 1 and 2, the minimum weight gain should be: 170 g
- in months 3 and 4: 110 g
- in months 5 and 6: 70 g and
- from month 7 to 12: 40 g

```
weight_measures_all <- weight_measures_all %>%
  mutate(color = ifelse(month <= 2 & diff_week >= 170, "ok",
                        ifelse(month == 3 & diff_week >= 110, "ok",
                               ifelse(month == 4 & diff_week >= 110, "ok",
                                      ifelse(month == 5 & diff_week >= 70, "ok",
                                             ifelse(month == 6 & diff_week >=
70, "ok",
                                                    ifelse(month >=7 & diff_week
>= 40, "ok", "low")))))))
```

The actual plot in the Shiny app is again created with **Plotly**, so you can interact with the graph there.

```
weight_measures_all %>%
  ggplot(aes(x = date, y = diff_week)) +
    geom_bar(aes(fill = color), stat = "identity") +
    geom_label(data = weight_measures_all %>% distinct(week, .keep_all = TRUE),
               aes(x = date, label = week),
               nudge_y = 50, alpha = 0.6) +
    scale_fill_brewer(palette = "Set1") +
    labs(x = "Week of life",
         y = "Weight difference in gramm",
         fill = "Weight gain",
         title = "Weekly weight differences",
         subtitle = "(Approximated) weight for each day compared to weight at 7
days prior;\nlabels: week of life") +
    theme_bw()
```



```
sessionInfo()
```

```
## R version 4.0.2 (2020-06-22)
## Platform: x86_64-apple-darwin17.0 (64-bit)
## Running under: macOS Catalina 10.15.6
##
## Matrix products: default
## BLAS:   /Library/Frameworks/R.framework/Versions/4.0/Resources/lib
/libRblas.dylib
## LAPACK: /Library/Frameworks/R.framework/Versions/4.0/Resources/lib
/libRlapack.dylib
##
## locale:
## [1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
##  [1] forcats_0.5.0   stringr_1.4.0   dplyr_1.0.2     purrr_0.3.4
##  [5] tidyr_1.1.2     tibble_3.0.3    ggplot2_3.3.2   tidyverse_1.3.0
##  [9] lubridate_1.7.9 readr_1.3.1
##
## loaded via a namespace (and not attached):
##  [1] tidyselect_1.1.0   xfun_0.16          haven_2.3.1
colorspace_1.4-1
##  [5] vctrs_0.3.3        generics_0.0.2     htmltools_0.5.0    yaml_2.2.1
##  [9] utf8_1.1.4         blob_1.2.1         rlang_0.4.7        pillar_1.4.6
## [13] withr_2.2.0        glue_1.4.2         DBI_1.1.0
RColorBrewer_1.1-2
## [17] dbplyr_1.4.4       modelr_0.1.8       readxl_1.3.1       lifecycle_0.2.0
## [21] munsell_0.5.0      blogdown_0.20      gtable_0.3.0
cellranger_1.1.0
## [25] rvest_0.3.6        evaluate_0.14      labeling_0.3       knitr_1.29
## [29] fansi_0.4.1        broom_0.7.0        Rcpp_1.0.5         backports_1.1.9
## [33] scales_1.1.1       jsonlite_1.7.0     farver_2.0.3       fs_1.5.0
## [37] hms_0.5.3          digest_0.6.25      stringi_1.4.6      bookdown_0.20
## [41] grid_4.0.2         cli_2.0.2          tools_4.0.2        magrittr_1.5
## [45] crayon_1.3.4       pkgconfig_2.0.3    ellipsis_0.3.1     xml2_1.3.2
## [49] reprex_0.3.0       rstudioapi_0.11    assertthat_0.2.1   rmarkdown_2.3
## [53] httr_1.4.2         R6_2.4.1           compiler_4.0.2
```