Animated Longitudinal Trajectories

The idea here is to create all plots (each *frame* in the animation) in advance, which is then stitched together using the `animation` package in LaTeX.

First, we define longitudinal trajectories for a stable and a declining patient, separately:

```
stable <- function(time) 60 - 0.01 * time + rnorm(n = length(time), sd = sqrt(5))
declining <- function(time) 60 - 3 * time + rnorm(n = length(time), sd = sqrt(5))
```

We then simulate two subjects:

```
set.seed(375683275)

patient_stable <- data.frame(
  id = 1,
  type = "Stable",
  adcens = 12,
  obtime = c(0, rep(3, 4))
) %>%
  mutate(t = cumsum(obtime)) %>%
  mutate(y = stable(t)) %>%
  filter(t <= adcens)

patient_declining <- data.frame(
  id = 2,
  type = "Declining",
  adcens = runif(1, 10, 12),
  obtime = c(0, rgamma(n = 100, shape = 2, scale = 0.25))
) %>%
  mutate(t = cumsum(obtime)) %>%
  mutate(y = declining(t)) %>%
  filter(t <= adcens)
```

We create a single dataset:

```
hcd <- bind_rows(patient_stable, patient_declining)
```

We also create a dataset to annotate outcomes:

```
outcome <- hcd %>%
  group_by(id) %>%
  filter(t == max(t))
```

We now start creating plots for each time point, which are:

```
time_points <- sort(unique(hcd$t))
time_points
```

```
##  [1]  0.000000  1.280807  1.509051  2.184977  2.704514  3.000000  3.054377
##  [8]  3.443566  4.131913  4.164542  4.271853  4.712551  5.431285  5.793062
## [15]  6.000000  6.411639  6.612505  7.428142  7.902333  8.141015  9.000000
## [22]  9.024912  9.260073  9.682912  9.904780 10.525818 11.151080 11.185485
## [29] 12.000000
```

Here we loop over possible time points:

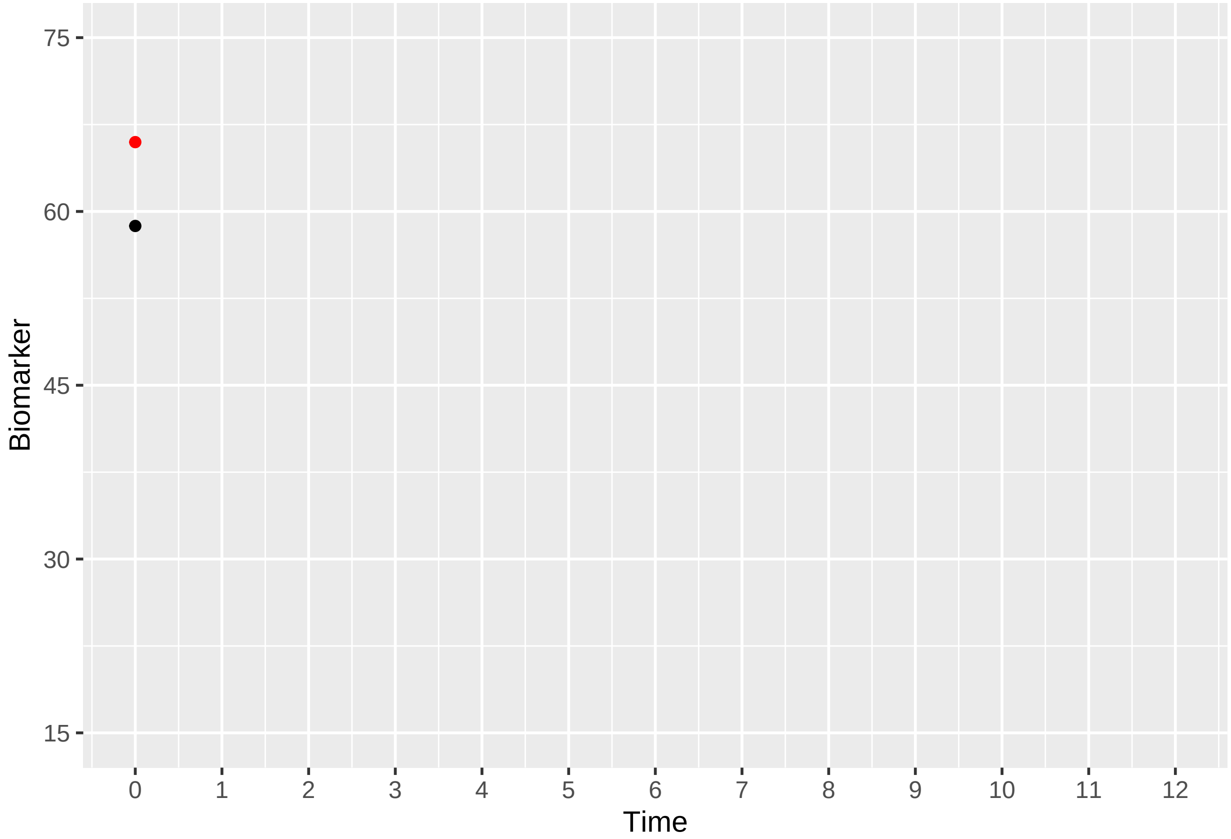
```
for (i in seq_along(time_points)) {
  nm1 <- nrow(filter(hcd, t <= time_points[i] & id == 1))
  nm2 <- nrow(filter(hcd, t <= time_points[i] & id == 2))
  plot <- ggplot(
    data = filter(hcd, t <= time_points[i]),
    aes(x = t, y = y, group = id, colour = type)
  ) +
    # geom_vline() highlights the current time
    # green for illustration purposes only
    geom_vline(xintercept = time_points[i], color = "green") +
    # geom_line() and geom_point() for each observation
    geom_line() +
    geom_point() +
    # annotation for the cumulative number of measurements
    annotate("text", x = 0, y = 15, label = paste("#:", nm2), color = "red") +
    annotate("text", x = 0, y = 75, label = paste("#:", nm1), color = "black") +
    # using color to match number of observations
    # (might need some fiddling around)
    scale_color_manual(values = c("red", "black")) +
    # scales and plotting area needs to be fixed, consistent over frames
    scale_y_continuous(breaks = seq(15, 75, by = 15)) +
    scale_x_continuous(breaks = 0:12) +
    coord_cartesian(xlim = c(0, 12), ylim = c(15, 75)) +
    # no need for a legend here
    theme(legend.position = "none") +
    labs(x = "Time", y = "Biomarker")
  # we add mortality/censoring outcomes when/if they happen
  # this is what the 'outcome' data.frame is used for
  if (time_points[i] >= outcome$t[1]) {
    plot <- plot +
      annotate("point", x = outcome$t[1], y = outcome$y[1], shape = 5, color = "green")
  }
  if (time_points[i] >= outcome$t[2]) {
    plot <- plot +
      annotate("point", x = outcome$t[2], y = outcome$y[2], shape = 10, color = "green")
  }
  # then, saving each 'frame'
  ggplot2::ggsave(
    plot = plot,
    filename = paste0("Plots/frame-", i, ".pdf"),
    width = 5, height = 5, dpi = 300
  )
}
```

```
## geom_path: Each group consists of only one observation. Do you need to adjust
## the group aesthetic?
```

The plot at "time zero" to set up the stage is:

```
ggplot(filter(hcd, t == 0), aes(x = t, y = y, group = id, colour = type)) +
  geom_point() +
  # note:
```

```
  # same scale, plotting area, labels, etc.
  scale_color_manual(values = c("red", "black")) +
  scale_y_continuous(breaks = seq(15, 75, by = 15)) +
  scale_x_continuous(breaks = 0:12) +
  coord_cartesian(xlim = c(0, 12), ylim = c(15, 75)) +
  labs(x = "Time", y = "Biomarker") +
  theme(legend.position = "none")
```



Then, the following LaTeX code combines the frame that we created before:

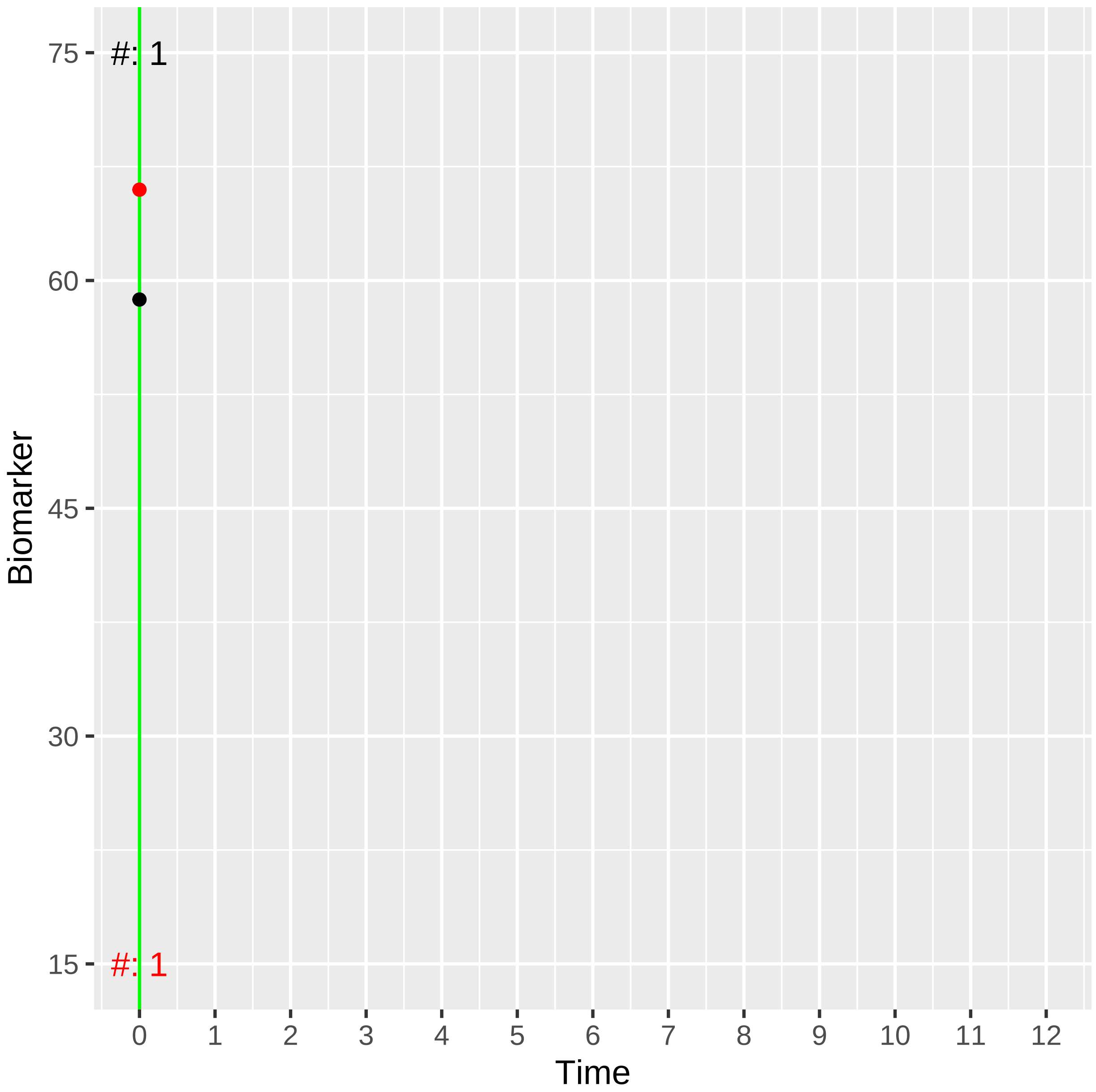
```
\begin{center}
\animategraphics[autoplay, width = \textwidth]{4}{Plots/frame-}{1}{29}
\end{center}
```

29 here is the total number of time points:

```
length(time_points)
```

```
## [1] 29
```

The result is:



Note that this requires `\usepackage{animate}` in the header of the document.