Assignment9

2023-01-31

```
library(aaltobda)
library(tidyverse)
```

```
## ── Attaching packages ─────────────────────────────────────── tidyverse 1.3.2 ──
## ✔ ggplot2 3.3.6     ✔ purrr   0.3.4
## ✔ tibble  3.1.8     ✔ dplyr   1.0.9
## ✔ tidyr   1.2.0     ✔ stringr 1.4.0
## ✔ readr   2.1.2     ✔ forcats 0.5.1
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
```

```
library(cmdstanr)
```

```
## This is cmdstanr version 0.5.3
## - CmdStanR documentation and vignettes: mc-stan.org/cmdstanr
## - Use set_cmdstan_path() to set the path to CmdStan
## - Use install_cmdstan() to install CmdStan
```

```
library(posterior)
```

```
## This is posterior version 1.3.0
##
## Attaching package: 'posterior'
##
## The following object is masked from 'package:aaltobda':
##
##     mcse_quantile
##
## The following objects are masked from 'package:stats':
##
##     mad, sd, var
```

```
set_cmdstan_path('/coursedata/cmdstan')
```

```
## CmdStan path set to: /coursedata/cmdstan
```

```
options(mc.cores = 1)
data('factory')
```

Part 1:

- If the product quality is above 85 then the company earns 200 -106 = 94 euros
- Else the company earns -106 euros

The utility function could be described as follow:

$$

$$
\begin{aligned}
U(x) &= 94 \ (x >= 85) \\
&= -106 \ (x < 85) \\
=> E[U(x)] &= P(x < 85) * (-106) + P(x >= 85) * 94
\end{aligned}
$$

$$

```
utility <- function(draws) {
  total <- length(draws)
  p_fail <-  sum(draws < 85) / total
  p_sold <- 1 - p_fail
  return(p_fail * (-106) + p_sold * (94))
}
```

```
hier_data = list(y = data.matrix(factory))

stan_code_hier <- "
// Separate model

data {
  matrix[5, 6] y; // data
}
parameters {
  real<lower = 0> sigma_0;
  real mu_0;
  vector[6] mu;
  real<lower = 0> sigma;
}
model {
  mu_0 ~ normal(0, 10);
  mu ~ normal(mu_0, sigma_0);
  sigma_0 ~ gamma(1,1);
  sigma ~ gamma(1, 1);
  for (i in 1:6) {
    y[, i] ~ normal(mu[i], sigma);
  }
}
generated quantities {
  vector[7] ypred;
  for (i in 1:6) {
     ypred[i] = normal_rng(mu[i], sigma);
  }
  ypred[7] = normal_rng(mu_0, sigma);
}
"
```

```
data <- as_data_frame(hier_model$draws(variables = 'ypred'))
```

```
## Warning: `as_data_frame()` was deprecated in tibble 2.0.0.
## Please use `as_tibble()` instead.
## The signature and semantics have changed, see `?as_tibble`.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was generated.
```

```
v1 <- utility(c(data$`1.ypred[1]`, data$`2.ypred[1]`, data$`3.ypred[1]`, data$`4.ypred
[1]`))
v2 <- utility(c(data$`1.ypred[2]`, data$`2.ypred[2]`, data$`3.ypred[2]`, data$`4.ypred
[2]`))
v3 <- utility(c(data$`1.ypred[3]`, data$`2.ypred[3]`, data$`3.ypred[3]`, data$`4.ypred
[3]`))
v4 <- utility(c(data$`1.ypred[4]`, data$`2.ypred[4]`, data$`3.ypred[4]`, data$`4.ypred
[4]`))
v5 <- utility(c(data$`1.ypred[5]`, data$`2.ypred[5]`, data$`3.ypred[5]`, data$`4.ypred
[5]`))
v6 <- utility(c(data$`1.ypred[6]`, data$`2.ypred[6]`, data$`3.ypred[6]`, data$`4.ypred
[6]`))
v7 <- utility(c(data$`1.ypred[7]`, data$`2.ypred[7]`, data$`3.ypred[7]`, data$`4.ypred
[7]`))
```

The utility value for each factories are followed:

```
print(c(v1,v2,v3,v4,v5,v6,v7))
```

```
## [1] -59.25  65.90  -3.75  77.10   8.85 -13.00 -73.90
```

Part 2:

V1, V6, V3, V5, V2, V4

Part 3:

The expected utility for the new machine is -73.9

Part 4:

Based on the estimated utility of the new machine, we should not buy a new machine.