BDA - Assignment 9

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Exercise 1

Stan-code: The hierarchial model

```
data {
  int<lower=0> N; // number of measurements
  int<lower=0> K; // number of machines
  int<lower=1,upper=K> x[N];
  vector[N] y; // measurements
}
parameters {
  real mu0;
  real<lower=0> sigma0;
  vector[K+1] mu; //add the seventh machine
  real<lower=0> sigma;
}
model {
  mu ~ normal(mu0, sigma0); //prior
  y ~ normal(mu[x], sigma); //same seller=same deviation assumed
}
generated quantities {
  vector[K+1] ypred;
  for (i in 1:(K+1)){
    ypred[i] = normal_rng(mu[i], sigma);
  }
}
```

The utility function

```
utility <- function(draws){
  u <- length(draws[draws < 85])*(-106) + length(draws[draws >= 85])*(94)
  return(u/length(draws))
}
```

```
mark_my_assignment()
```

```
## v |  OK F W S | Context
##
/ |   0       | utility()
v |   4       | utility()
##
## == Results =====================================================================
## Duration: 0.1 s
##
## OK:       4
## Failed:   0
## Warnings: 0
## Skipped:  0
## Good work!
```

The expected utility of one product of each machine.

```
# Data preparation
data("factory")

N <- ncol(factory) * nrow(factory)
K <- ncol(factory)
x <- rep(1:ncol(factory), nrow(factory))
y <- factory

df <- list(N=N, K=K, x=x, y=c(t(y)))
```

```
# Run the stan-script
fit_factory_hierarchical <- stan(
  file = "hierarchial_model.stan",
  data = df,
  iter = 8000,
  control = list(adapt_delta = 0.99),
  refresh = 0
)
```

```
## Warning in readLines(file, warn = TRUE): incomplete final line found on 'C:
## \Users\alisa_000\Documents\BDA\hierarchial_model.stan'
```

```
## Warning: There were 8 divergent transitions after warmup. Increasing adapt_delta above 0.99 may help
## http://mc-stan.org/misc/warnings.html#divergent-transitions-after-warmup
```

```
## Warning: Examine the pairs() plot to diagnose sampling problems
```

```
# Combine the results to a data frame
df_factory_hierarchical <- as.data.frame(fit_factory_hierarchical)
```

The results for each machine

```
machine1 <- utility(df_factory_hierarchical$`ypred[1]`)
paste("The expected utility for machine 1: ", machine1)
```

```
## [1] "The expected utility for machine 1:  -32.55"
```

```
machine2 <- utility(df_factory_hierarchical$`ypred[2]`)
paste("The expected utility for machine 2: ", machine2)
```

```
## [1] "The expected utility for machine 2:  67.125"
```

```
machine3 <- utility(df_factory_hierarchical$`ypred[3]`)
paste("The expected utility for machine 3: ", machine3)
```

```
## [1] "The expected utility for machine 3:  13.25"
```

```
machine4 <- utility(df_factory_hierarchical$`ypred[4]`)
paste("The expected utility for machine 4: ", machine4)
```

```
## [1] "The expected utility for machine 4:  75.0625"
```

```
machine5 <- utility(df_factory_hierarchical$`ypred[5]`)
paste("The expected utility for machine 5: ", machine5)
```

```
## [1] "The expected utility for machine 5:  20.9625"
```

```
machine6 <- utility(df_factory_hierarchical$`ypred[6]`)
paste("The expected utility for machine 6: ", machine6)
```

```
## [1] "The expected utility for machine 6:  5.925"
```

Exercise 2

The machines ranked from worst to best

M1, M6, M3, M5, M2, M4

Some discussion

Based on the expected utilities, only the machine 1 is non-profitable as the expected value is negative. This means, on the long run, the company owner would lose more money than earn with the machine number 1.

The rest of the machines (2, 3, 4, 5, 6) have positive expected utility, so on the long run, the machines make money for the company owner.

Exercise 3

The code for getting the information from the additional seventh machine is included in the stan's generated quantities and R-code above.

```
machine7 <- utility(df_factory_hierarchical$`ypred[7]`)
paste("The expected utility for machine 7: ", machine7)
```

```
## [1] "The expected utility for machine 7:  21.4125"
```

Exercise 4

Should the company by a seventh machine from the same seller?

Yes. The expected utility for a seventh machine is positive, so on the long run, the new machine would bring money into the company, on average, around 20 dollars per product (the exact value could change due to random fluctuations). Note that the new machine should be bought from the same seller!

Exercise 5

All the relevant scritps and codes can be found above.