> ########## ########## Simulation Dietary Fat Beispiel mit Random Effects mit STAN ########## ##########

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>

> ##### Clear data

> rm(list=ls())

>

>

>

> ##### Setting working directory

> setwd("C:/Users/IvanB/Desktop/Masterarbeit/Statistische Programme und Gibbs Sampler/STAN/Nachrechnen TSD2/DietaryFat")

>

>

>

> ##### Requiering stan

> library("rstan")

> library("rstantools")

> rstan\_options(auto\_write = TRUE)

> #options(mc.cores = parallel::detectCores())

> Sys.setenv(LOCAL\_CPPFLAGS = '-march=native')

>

>

>

> ##### Read in data

> data = read.csv2("DietaryFat\_Data\_neu sortiert\_II\_ohneNA.csv", header=TRUE, sep = ";", quote = "\"", dec = ",", fill = TRUE, comment.char = "")

> head(data) # Shows the first six entries

Treatment\_t Explosure\_time\_E Erfolge\_r Studie Studienarm ID

1 1 1917.0 113 1 2 #2\_DART

2 1 43.6 1 2 3 #10\_London Corn /Olive

3 1 393.5 24 3 2 #11\_London Low Fat

4 1 4715.0 248 4 2 #14\_Minnesota Coronary

5 1 715.0 31 5 2 #15\_MRC Soya

6 1 885.0 65 6 2 #18\_Oslo Diet-Heart

> #data2 = read.table("DietaryFat\_Data\_Rest.txt")

> #head(data2) # Shows the first six entries

>

>

>

> ##### Assignment data to stan

> NO =nrow(data)

> NT=max(data$Treatment\_t )

> NS=max(data$Studie)

> E=data$Explosure\_time\_E

> r=data$Erfolge\_r

> t=data$Treatment\_t

> s=data$Studie

> base=data$Treatment\_t

>

> data\_list <- list(NO=NO, NT=NT, NS=NS, E=E, r=r, t=t, s=s,base=base)

>

>

>

> ##### Read in inits

> inits1 <- function(chain\_id = 1) { #\*

+ list(d=c( NA, 0, 0),

+ sd=1,

+ mu=c(0, 0, 0, 0, 0, 0, 0, 0, 0, 0))

+ }

>

> inits2 <- function(chain\_id = 2) {

+ list(d=c( NA, -1, -1),

+ sd=4,

+ mu=c(-3, -3, -3, -3, -3, -3, -3, -3, -3, -3))

+ }

>

> inits3 <- function(chain\_id = 3) { #\*

+ list(d=c( NA, 2, 2),

+ sd=2,

+ mu=c(3, 5, 1, 3, 7, 3, 4, 3, 3, 0))

+ }

>

> all.inits <- list(inits1, inits2, inits3)

> #all.inits

>

> #\* Hinweis:

> # Chain 3: Rejecting initial value:

> # Chain 3: Log probability evaluates to log(0), i.e. negative infinity.

> # Chain 3: Stan can't start sampling from this initial value.

> # => negative Werte zu positiv geändert

> # inits für Kette 1+2+4 auch. Aber augenscheinlich keine Probleme

>

>

>

> ##### Compiling

> m <- stan\_model('Model\_Random\_final.stan')

hash mismatch so recompiling; make sure Stan code ends with a blank line

> m <- stan\_model('Model\_Random\_final.stan')

>

>

>

> ##### Simulation

> #stan\_samples <- sampling(m, data = data\_list, iter=20000, verbose=T, chain=4, control = list(adapt\_delta = 0.99)) # dauert zu lange

> stan\_samples <- sampling(m, data = data\_list, iter=100000, verbose=T, chain=4, control = list(adapt\_delta = 0.90)) # optimalere Lösung

CHECKING DATA AND PREPROCESSING FOR MODEL 'Model\_Random\_final' NOW.

COMPILING MODEL 'Model\_Random\_final' NOW.

STARTING SAMPLER FOR MODEL 'Model\_Random\_final' NOW.

SAMPLING FOR MODEL 'Model\_Random\_final' NOW (CHAIN 1).

Chain 1: Rejecting initial value:

Chain 1: Log probability evaluates to log(0), i.e. negative infinity.

Chain 1: Stan can't start sampling from this initial value.

Chain 1:

Chain 1: Gradient evaluation took 0.001 seconds

Chain 1: 1000 transitions using 10 leapfrog steps per transition would take 10 seconds.

Chain 1: Adjust your expectations accordingly!

Chain 1:

Chain 1:

Chain 1: Iteration: 1 / 100000 [ 0%] (Warmup)

Chain 1: Iteration: 10000 / 100000 [ 10%] (Warmup)

Chain 1: Iteration: 20000 / 100000 [ 20%] (Warmup)

Chain 1: Iteration: 30000 / 100000 [ 30%] (Warmup)

Chain 1: Iteration: 40000 / 100000 [ 40%] (Warmup)

Chain 1: Iteration: 50000 / 100000 [ 50%] (Warmup)

Chain 1: Iteration: 50001 / 100000 [ 50%] (Sampling)

Chain 1: Iteration: 60000 / 100000 [ 60%] (Sampling)

Chain 1: Iteration: 70000 / 100000 [ 70%] (Sampling)

Chain 1: Iteration: 80000 / 100000 [ 80%] (Sampling)

Chain 1: Iteration: 90000 / 100000 [ 90%] (Sampling)

Chain 1: Iteration: 100000 / 100000 [100%] (Sampling)

Chain 1:

Chain 1: Elapsed Time: 95.353 seconds (Warm-up)

Chain 1: 91.646 seconds (Sampling)

Chain 1: 186.999 seconds (Total)

Chain 1:

SAMPLING FOR MODEL 'Model\_Random\_final' NOW (CHAIN 2).

Chain 2:

Chain 2: Gradient evaluation took 0.001 seconds

Chain 2: 1000 transitions using 10 leapfrog steps per transition would take 10 seconds.

Chain 2: Adjust your expectations accordingly!

Chain 2:

Chain 2:

Chain 2: Iteration: 1 / 100000 [ 0%] (Warmup)

Chain 2: Iteration: 10000 / 100000 [ 10%] (Warmup)

Chain 2: Iteration: 20000 / 100000 [ 20%] (Warmup)

Chain 2: Iteration: 30000 / 100000 [ 30%] (Warmup)

Chain 2: Iteration: 40000 / 100000 [ 40%] (Warmup)

Chain 2: Iteration: 50000 / 100000 [ 50%] (Warmup)

Chain 2: Iteration: 50001 / 100000 [ 50%] (Sampling)

Chain 2: Iteration: 60000 / 100000 [ 60%] (Sampling)

Chain 2: Iteration: 70000 / 100000 [ 70%] (Sampling)

Chain 2: Iteration: 80000 / 100000 [ 80%] (Sampling)

Chain 2: Iteration: 90000 / 100000 [ 90%] (Sampling)

Chain 2: Iteration: 100000 / 100000 [100%] (Sampling)

Chain 2:

Chain 2: Elapsed Time: 84.035 seconds (Warm-up)

Chain 2: 90.985 seconds (Sampling)

Chain 2: 175.02 seconds (Total)

Chain 2:

SAMPLING FOR MODEL 'Model\_Random\_final' NOW (CHAIN 3).

Chain 3:

Chain 3: Gradient evaluation took 0 seconds

Chain 3: 1000 transitions using 10 leapfrog steps per transition would take 0 seconds.

Chain 3: Adjust your expectations accordingly!

Chain 3:

Chain 3:

Chain 3: Iteration: 1 / 100000 [ 0%] (Warmup)

Chain 3: Iteration: 10000 / 100000 [ 10%] (Warmup)

Chain 3: Iteration: 20000 / 100000 [ 20%] (Warmup)

Chain 3: Iteration: 30000 / 100000 [ 30%] (Warmup)

Chain 3: Iteration: 40000 / 100000 [ 40%] (Warmup)

Chain 3: Iteration: 50000 / 100000 [ 50%] (Warmup)

Chain 3: Iteration: 50001 / 100000 [ 50%] (Sampling)

Chain 3: Iteration: 60000 / 100000 [ 60%] (Sampling)

Chain 3: Iteration: 70000 / 100000 [ 70%] (Sampling)

Chain 3: Iteration: 80000 / 100000 [ 80%] (Sampling)

Chain 3: Iteration: 90000 / 100000 [ 90%] (Sampling)

Chain 3: Iteration: 100000 / 100000 [100%] (Sampling)

Chain 3:

Chain 3: Elapsed Time: 85.391 seconds (Warm-up)

Chain 3: 78.407 seconds (Sampling)

Chain 3: 163.798 seconds (Total)

Chain 3:

SAMPLING FOR MODEL 'Model\_Random\_final' NOW (CHAIN 4).

Chain 4:

Chain 4: Gradient evaluation took 0 seconds

Chain 4: 1000 transitions using 10 leapfrog steps per transition would take 0 seconds.

Chain 4: Adjust your expectations accordingly!

Chain 4:

Chain 4:

Chain 4: Iteration: 1 / 100000 [ 0%] (Warmup)

Chain 4: Iteration: 10000 / 100000 [ 10%] (Warmup)

Chain 4: Iteration: 20000 / 100000 [ 20%] (Warmup)

Chain 4: Iteration: 30000 / 100000 [ 30%] (Warmup)

Chain 4: Iteration: 40000 / 100000 [ 40%] (Warmup)

Chain 4: Iteration: 50000 / 100000 [ 50%] (Warmup)

Chain 4: Iteration: 50001 / 100000 [ 50%] (Sampling)

Chain 4: Iteration: 60000 / 100000 [ 60%] (Sampling)

Chain 4: Iteration: 70000 / 100000 [ 70%] (Sampling)

Chain 4: Iteration: 80000 / 100000 [ 80%] (Sampling)

Chain 4: Iteration: 90000 / 100000 [ 90%] (Sampling)

Chain 4: Iteration: 100000 / 100000 [100%] (Sampling)

Chain 4:

Chain 4: Elapsed Time: 81.988 seconds (Warm-up)

Chain 4: 74.837 seconds (Sampling)

Chain 4: 156.825 seconds (Total)

Chain 4:

Warning messages:

1: There were 31827 divergent transitions after warmup. Increasing adapt\_delta above 0.9 may help. See

http://mc-stan.org/misc/warnings.html#divergent-transitions-after-warmup

2: Examine the pairs() plot to diagnose sampling problems

>

>

>

> ##### Plotting and summarizing the posterior distribution

> stan\_samples # = print(stan\_samples)

Inference for Stan model: Model\_Random\_final.

4 chains, each with iter=1e+05; warmup=50000; thin=1;

post-warmup draws per chain=50000, total post-warmup draws=2e+05.

mean se\_mean sd 2.5% 25% 50% 75% 97.5% n\_eff Rhat

d[1] 0.00 0.00 0.32 -0.62 -0.21 0.00 0.21 0.62 228200 1

d[2] 0.00 0.00 0.30 -0.59 -0.20 0.00 0.20 0.59 226209 1

mu[1] 0.00 0.00 0.71 -1.39 -0.48 0.00 0.47 1.37 218684 1

mu[2] 0.00 0.00 0.58 -1.13 -0.39 0.00 0.39 1.13 228314 1

mu[3] 0.00 0.00 0.71 -1.39 -0.48 0.00 0.48 1.38 225902 1

mu[4] 0.00 0.00 0.71 -1.39 -0.48 0.00 0.47 1.39 227316 1

mu[5] 0.00 0.00 0.71 -1.38 -0.48 0.00 0.48 1.39 226058 1

mu[6] 0.00 0.00 0.71 -1.39 -0.48 0.00 0.48 1.39 224145 1

mu[7] 0.00 0.00 0.71 -1.39 -0.48 0.00 0.47 1.39 228840 1

mu[8] 0.00 0.00 0.70 -1.38 -0.48 0.00 0.47 1.38 229384 1

mu[9] 0.00 0.00 0.70 -1.38 -0.47 0.00 0.48 1.38 230303 1

mu[10] -2.82 0.00 0.05 -2.93 -2.86 -2.82 -2.78 -2.71 60718 1

delta[1] -0.01 0.00 0.07 -0.15 -0.06 -0.01 0.04 0.14 145470 1

delta[2] -0.02 0.00 0.10 -0.21 -0.08 -0.02 0.05 0.18 229017 1

delta[3] 0.00 0.00 0.09 -0.18 -0.06 0.00 0.06 0.18 216828 1

delta[4] -0.09 0.00 0.07 -0.22 -0.13 -0.09 -0.05 0.04 105834 1

delta[5] -0.08 0.00 0.09 -0.25 -0.14 -0.08 -0.03 0.09 201188 1

delta[6] 0.08 0.00 0.08 -0.08 0.02 0.08 0.13 0.24 193302 1

delta[7] -0.02 0.00 0.10 -0.21 -0.09 -0.02 0.04 0.17 233939 1

delta[8] -0.21 0.00 0.08 -0.38 -0.27 -0.21 -0.15 -0.05 197508 1

delta[9] 0.40 0.00 0.07 0.26 0.35 0.40 0.45 0.54 137565 1

delta[10] -0.05 0.00 0.10 -0.24 -0.12 -0.05 0.01 0.14 221156 1

delta[11] -0.04 0.00 0.11 -0.25 -0.11 -0.03 0.04 0.17 120672 1

delta[12] 0.34 0.00 0.38 -0.40 0.08 0.33 0.59 1.08 152688 1

delta[13] -0.11 0.00 0.21 -0.53 -0.24 -0.10 0.04 0.29 167969 1

delta[14] -0.07 0.00 0.08 -0.23 -0.12 -0.07 -0.01 0.09 94143 1

delta[15] -0.42 0.00 0.18 -0.79 -0.54 -0.41 -0.29 -0.08 148578 1

delta[16] -0.11 0.00 0.15 -0.40 -0.20 -0.10 -0.01 0.17 155828 1

delta[17] -0.61 0.00 0.46 -1.65 -0.88 -0.56 -0.29 0.14 73958 1

delta[18] -0.33 0.00 0.16 -0.66 -0.44 -0.33 -0.23 -0.03 152925 1

delta[19] 0.59 0.00 0.09 0.41 0.53 0.59 0.65 0.77 108138 1

delta[20] -0.75 0.00 0.46 -1.80 -1.03 -0.70 -0.42 0.00 68389 1

delta[21] 0.08 0.00 0.40 -0.74 -0.17 0.09 0.35 0.86 147498 1

s\_d 0.33 0.00 0.21 0.07 0.17 0.27 0.44 0.87 63580 1

A[1] -3.00 0.00 0.56 -4.10 -3.38 -3.00 -2.62 -1.90 227491 1

A[2] -3.00 0.00 0.56 -4.10 -3.38 -3.00 -2.62 -1.89 228292 1

d\_II[1] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

d\_II[2] 0.00 0.00 0.30 -0.59 -0.20 0.00 0.20 0.59 226209 1

tau 0.54 0.00 0.18 0.26 0.41 0.52 0.66 0.93 68284 1

w[1,1] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

w[1,2] -0.04 0.00 0.11 -0.25 -0.11 -0.03 0.04 0.17 120672 1

w[2,1] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

w[2,2] 0.08 0.00 0.40 -0.74 -0.17 0.09 0.35 0.86 147498 1

w[3,1] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

w[3,2] -0.11 0.00 0.21 -0.53 -0.24 -0.10 0.04 0.29 167969 1

w[4,1] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

w[4,2] -0.07 0.00 0.08 -0.23 -0.12 -0.07 -0.01 0.09 94143 1

w[5,1] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

w[5,2] -0.42 0.00 0.18 -0.79 -0.54 -0.41 -0.29 -0.08 148578 1

w[6,1] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

w[6,2] -0.11 0.00 0.15 -0.40 -0.20 -0.10 -0.01 0.17 155828 1

w[7,1] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

w[7,2] -0.61 0.00 0.46 -1.65 -0.88 -0.56 -0.29 0.14 73958 1

w[8,1] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

w[8,2] -0.33 0.00 0.16 -0.66 -0.44 -0.33 -0.23 -0.03 152925 1

w[9,1] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

w[9,2] 0.59 0.00 0.09 0.41 0.53 0.59 0.65 0.77 108138 1

w[10,1] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

w[10,2] -0.75 0.00 0.46 -1.80 -1.03 -0.70 -0.42 0.00 68389 1

sw\_vec[1] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[2] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[3] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[4] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[5] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[6] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[7] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[8] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[9] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[10] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[11] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[12] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[13] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[14] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[15] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[16] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[17] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[18] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[19] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[20] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

sw\_vec[21] 0.00 NaN 0.00 0.00 0.00 0.00 0.00 0.00 NaN NaN

vard\_vec[1] 0.01 0.00 0.00 0.01 0.01 0.01 0.01 0.01 2 1

vard\_vec[2] 0.01 0.00 0.00 0.01 0.01 0.01 0.01 0.01 2 1

vard\_vec[3] 0.01 0.00 0.00 0.01 0.01 0.01 0.01 0.01 2 1

vard\_vec[4] 0.01 0.00 0.00 0.01 0.01 0.01 0.01 0.01 2 1

vard\_vec[5] 0.01 0.00 0.00 0.01 0.01 0.01 0.01 0.01 2 1

vard\_vec[6] 0.01 0.00 0.00 0.01 0.01 0.01 0.01 0.01 2 1

vard\_vec[7] 0.01 0.00 0.00 0.01 0.01 0.01 0.01 0.01 2 1

vard\_vec[8] 0.01 0.00 0.00 0.01 0.01 0.01 0.01 0.01 2 1

vard\_vec[9] 0.01 0.00 0.00 0.01 0.01 0.01 0.01 0.01 2 1

vard\_vec[10] 0.01 0.00 0.00 0.01 0.01 0.01 0.01 0.01 2 1

vard\_vec[11] 0.33 0.00 0.21 0.07 0.17 0.27 0.44 0.87 63580 1

vard\_vec[12] 0.33 0.00 0.21 0.07 0.17 0.27 0.44 0.87 63580 1

vard\_vec[13] 0.33 0.00 0.21 0.07 0.17 0.27 0.44 0.87 63580 1

vard\_vec[14] 0.33 0.00 0.21 0.07 0.17 0.27 0.44 0.87 63580 1

vard\_vec[15] 0.33 0.00 0.21 0.07 0.17 0.27 0.44 0.87 63580 1

vard\_vec[16] 0.33 0.00 0.21 0.07 0.17 0.27 0.44 0.87 63580 1

vard\_vec[17] 0.33 0.00 0.21 0.07 0.17 0.27 0.44 0.87 63580 1

vard\_vec[18] 0.33 0.00 0.21 0.07 0.17 0.27 0.44 0.87 63580 1

vard\_vec[19] 0.33 0.00 0.21 0.07 0.17 0.27 0.44 0.87 63580 1

vard\_vec[20] 0.33 0.00 0.21 0.07 0.17 0.27 0.44 0.87 63580 1

[ reached getOption("max.print") -- omitted 131 rows ]

Samples were drawn using NUTS(diag\_e) at Sat Aug 24 21:40:35 2019.

For each parameter, n\_eff is a crude measure of effective sample size,

and Rhat is the potential scale reduction factor on split chains (at

convergence, Rhat=1).

> plot(stan\_samples)

'pars' not specified. Showing first 10 parameters by default.

ci\_level: 0.8 (80% intervals)

outer\_level: 0.95 (95% intervals)

> Stan\_summary <- summary(stan\_samples, pars = c("d[2]","d\_II[2]", "T[1]", "T[2]", "s\_d", "totalresdev", "dev", "theta"), probs = c(0.025, 0.975))$summary

> Stan\_summary

mean se\_mean sd 2.5% 97.5% n\_eff Rhat

d[2] 9.249507e-05 0.0006341991 0.30163429 -5.918210e-01 0.5904113 226209.17 0.9999925

d\_II[2] 9.249507e-05 0.0006341991 0.30163429 -5.918210e-01 0.5904113 226209.17 0.9999925

T[1] 5.826756e-02 0.0000844281 0.03548515 1.655825e-02 0.1496987 176652.25 1.0000015

T[2] 6.128188e-02 0.0001061844 0.04360196 1.419492e-02 0.1748126 168612.97 0.9999957

s\_d 3.282596e-01 0.0008422698 0.21237935 6.874442e-02 0.8715659 63580.23 1.0000977

totalresdev 4.921749e+01 0.0230108517 8.67480915 3.364539e+01 67.5093984 142119.76 1.0000027

dev[1] 6.083867e-01 0.0029230047 0.86313017 5.948050e-04 3.0706656 87195.40 1.0000279

dev[2] 1.269514e+00 0.0009227472 0.35392668 6.689985e-01 2.0481608 147116.43 1.0000042

dev[3] 2.441616e-01 0.0011312541 0.34282191 2.451386e-04 1.2201478 91836.82 1.0000613

dev[4] 1.083475e+00 0.0040665036 1.48139454 1.137921e-03 5.2576901 132708.63 1.0000267

dev[5] 2.192006e+00 0.0040977036 1.62530052 8.677747e-02 6.2005922 157320.84 1.0000047

dev[6] 1.497382e+00 0.0037466914 1.49012358 4.486972e-03 5.3841348 158178.96 1.0000164

dev[7] 1.099363e+00 0.0012495538 0.48295399 3.403788e-01 2.2149783 149383.15 1.0000079

dev[8] 1.091736e+01 0.0090541106 3.79273657 4.582161e+00 19.3332476 175474.40 1.0000076

dev[9] 1.137501e+01 0.0120749430 5.58678135 2.553127e+00 24.0986339 214068.70 0.9999868

dev[10] 5.185560e+00 0.0028751185 1.11569763 3.236220e+00 7.5972125 150584.94 1.0000160

dev[11] 9.636368e-01 0.0049147389 1.36750078 9.701629e-04 4.8608384 77420.19 1.0000373

dev[12] 1.126362e+00 0.0036168994 1.25315478 1.906096e-03 4.4383251 120042.92 1.0000335

dev[13] 8.231673e-01 0.0043151293 1.17684793 8.010394e-04 4.1608108 74379.47 1.0000600

dev[14] 9.914330e-01 0.0044731835 1.40333174 9.602500e-04 5.0096352 98420.88 1.0000285

dev[15] 9.778043e-01 0.0044630748 1.36911836 9.837184e-04 4.8843867 94105.21 1.0000020

dev[16] 9.085953e-01 0.0046846205 1.29385244 8.601549e-04 4.5851501 76281.75 1.0000428

dev[17] 2.305449e+00 0.0047840718 1.84542420 2.443719e-02 6.8054669 148797.99 0.9999971

dev[18] 9.517609e-01 0.0046928436 1.34463398 9.463628e-04 4.8144039 82098.65 1.0000458

dev[19] 1.065133e+00 0.0048089632 1.49956036 1.101284e-03 5.3294222 97235.53 1.0000030

dev[20] 3.112610e+00 0.0063967511 2.31404508 6.641496e-02 8.6432151 130865.37 1.0000145

dev[21] 5.193196e-01 0.0026676379 0.71265647 5.765399e-04 2.5275540 71368.52 1.0000758

theta[1] 1.137526e+02 0.0179799976 8.31375689 9.814109e+01 130.7442670 213803.78 0.9999979

theta[2] 2.573998e+00 0.0007485827 0.28793668 2.054562e+00 3.1814026 147949.82 1.0000035

theta[3] 2.365256e+01 0.0057722224 2.36382344 1.931652e+01 28.5994413 167704.21 1.0000096

theta[4] 2.570997e+02 0.0283253560 14.21083808 2.301617e+02 285.7000518 251703.14 1.0000200

theta[5] 3.937372e+01 0.0089104520 3.67534543 3.260394e+01 47.0037257 170136.25 1.0000092

theta[6] 5.723106e+01 0.0114630700 4.96152674 4.804277e+01 67.4624941 187339.25 1.0000020

theta[7] 5.156299e+00 0.0014549841 0.56961456 4.127018e+00 6.3632880 153265.94 1.0000076

theta[8] 4.903708e+01 0.0103755663 4.39065840 4.090316e+01 58.1106850 179075.30 1.0000082

theta[9] 1.372594e+02 0.0199562076 9.46993400 1.194630e+02 156.5843661 225184.18 0.9999940

theta[10] 7.120774e+00 0.0019887207 0.77374391 5.719621e+00 8.7505435 151372.47 1.0000159

theta[11] 1.111850e+02 0.0204296703 10.34918099 9.178311e+01 132.3670095 256619.26 1.0000033

theta[12] 3.707691e+00 0.0039855335 1.45865402 1.646139e+00 7.2882829 133946.59 1.0000641

theta[13] 2.045287e+01 0.0088966717 4.11471764 1.320863e+01 29.3226644 213906.97 1.0000005

theta[14] 2.692829e+02 0.0325440039 16.34098218 2.382215e+02 302.1916694 252124.09 1.0000162

theta[15] 2.987764e+01 0.0113024476 5.20666806 2.050019e+01 40.8700195 212214.36 0.9999996

theta[16] 4.848292e+01 0.0136941725 6.64396733 3.633992e+01 62.2679866 235387.49 0.9999942

theta[17] 3.230722e+00 0.0038512712 1.34696268 1.042220e+00 6.2325131 122321.53 1.0000088

theta[18] 4.052166e+01 0.0130407207 6.12088370 2.937575e+01 53.4175256 220305.36 0.9999970

theta[19] 1.711805e+02 0.0268236111 13.09526454 1.465249e+02 197.7322533 238338.42 1.0000097

theta[20] 3.793641e+00 0.0047556667 1.58715515 1.216321e+00 7.3109857 111382.24 1.0000137

theta[21] 2.667965e+00 0.0029033859 1.09768300 1.078184e+00 5.3574919 142936.89 1.0000749

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> ##### Additional Lines for Median

> Median\_d2 <- median(as.matrix(stan\_samples, pars = c("d\_II[2]")))

> Median\_d2

[1] -2.446756e-05

> Median\_T1 <- median(as.matrix(stan\_samples, pars = c("T[1]")))

> Median\_T1

[1] 0.04978477

> Median\_T2 <- median(as.matrix(stan\_samples, pars = c("T[2]")))

> Median\_T2

[1] 0.04991758

> Median\_sd <- median(as.matrix(stan\_samples, pars = c("s\_d")))

> Median\_sd

[1] 0.270663

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> # Section for Convergence Diagnostic --------------------------------------------------

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>

> # konkreter Vergleich mit BUGS nicht möglich ->kein pD in dem Sinne

> # DIC (und damit pD) ist veraltet

> # => loo()-Fkt und WAIC

> #(pD Code für Python)

> #allerdings andere Konvergenz - Diagnostika:

> # Diagnostik mir rstan Paket

> sampler\_params <- get\_sampler\_params(stan\_samples, inc\_warmup = TRUE)

> summary(do.call(rbind, sampler\_params), digits = 2)

accept\_stat\_\_ stepsize\_\_ treedepth\_\_ n\_leapfrog\_\_ divergent\_\_ energy\_\_

Min. :0.00 Min. :8.8e-04 Min. : 0.0 Min. : 1 Min. :0.00 Min. : -5352

1st Qu.:0.89 1st Qu.:2.3e-01 1st Qu.: 4.0 1st Qu.: 15 1st Qu.:0.00 1st Qu.: -5335

Median :0.95 Median :2.9e-01 Median : 4.0 Median : 15 Median :0.00 Median : -5331

Mean :0.91 Mean :2.8e-01 Mean : 3.7 Mean : 15 Mean :0.17 Mean : -5329

3rd Qu.:0.99 3rd Qu.:3.1e-01 3rd Qu.: 4.0 3rd Qu.: 15 3rd Qu.:0.00 3rd Qu.: -5327

Max. :1.00 Max. :1.2e+01 Max. :10.0 Max. :1023 Max. :1.00 Max. :101126

> # each chain separately

> lapply(sampler\_params, summary, digits = 2)

[[1]]

accept\_stat\_\_ stepsize\_\_ treedepth\_\_ n\_leapfrog\_\_ divergent\_\_ energy\_\_

Min. :0.00 Min. : 0.001 Min. : 0.0 Min. : 1 Min. :0.00 Min. : -5350

1st Qu.:0.88 1st Qu.: 0.293 1st Qu.: 4.0 1st Qu.: 15 1st Qu.:0.00 1st Qu.: -5335

Median :0.95 Median : 0.293 Median : 4.0 Median : 15 Median :0.00 Median : -5331

Mean :0.90 Mean : 0.296 Mean : 3.7 Mean : 14 Mean :0.18 Mean : -5328

3rd Qu.:0.99 3rd Qu.: 0.308 3rd Qu.: 4.0 3rd Qu.: 15 3rd Qu.:0.00 3rd Qu.: -5327

Max. :1.00 Max. :11.994 Max. :10.0 Max. :1023 Max. :1.00 Max. :101126

[[2]]

accept\_stat\_\_ stepsize\_\_ treedepth\_\_ n\_leapfrog\_\_ divergent\_\_ energy\_\_

Min. :0.00 Min. : 0.0014 Min. : 0.0 Min. : 1 Min. :0.00 Min. :-5351

1st Qu.:0.90 1st Qu.: 0.2152 1st Qu.: 4.0 1st Qu.: 15 1st Qu.:0.00 1st Qu.:-5335

Median :0.96 Median : 0.2152 Median : 4.0 Median : 15 Median :0.00 Median :-5331

Mean :0.92 Mean : 0.2559 Mean : 3.7 Mean : 15 Mean :0.16 Mean :-5328

3rd Qu.:0.99 3rd Qu.: 0.3083 3rd Qu.: 4.0 3rd Qu.: 15 3rd Qu.:0.00 3rd Qu.:-5327

Max. :1.00 Max. :11.9940 Max. :10.0 Max. :1023 Max. :1.00 Max. :89071

[[3]]

accept\_stat\_\_ stepsize\_\_ treedepth\_\_ n\_leapfrog\_\_ divergent\_\_ energy\_\_

Min. :0.00 Min. : 0.004 Min. : 0.0 Min. : 1 Min. :0.00 Min. :-5351

1st Qu.:0.87 1st Qu.: 0.300 1st Qu.: 4.0 1st Qu.: 15 1st Qu.:0.00 1st Qu.:-5335

Median :0.94 Median : 0.300 Median : 4.0 Median : 15 Median :0.00 Median :-5331

Mean :0.90 Mean : 0.301 Mean : 3.7 Mean : 14 Mean :0.18 Mean :-5330

3rd Qu.:0.98 3rd Qu.: 0.311 3rd Qu.: 4.0 3rd Qu.: 15 3rd Qu.:0.00 3rd Qu.:-5327

Max. :1.00 Max. :11.994 Max. :10.0 Max. :1023 Max. :1.00 Max. : 3681

[[4]]

accept\_stat\_\_ stepsize\_\_ treedepth\_\_ n\_leapfrog\_\_ divergent\_\_ energy\_\_

Min. :0.00 Min. :8.8e-04 Min. : 0.0 Min. : 1 Min. :0.00 Min. :-5351

1st Qu.:0.90 1st Qu.:2.3e-01 1st Qu.: 4.0 1st Qu.: 15 1st Qu.:0.00 1st Qu.:-5335

Median :0.96 Median :2.3e-01 Median : 4.0 Median : 15 Median :0.00 Median :-5331

Mean :0.92 Mean :2.7e-01 Mean : 3.7 Mean : 14 Mean :0.16 Mean :-5330

3rd Qu.:0.99 3rd Qu.:3.1e-01 3rd Qu.: 4.0 3rd Qu.: 15 3rd Qu.:0.00 3rd Qu.:-5327

Max. :1.00 Max. :1.2e+01 Max. :10.0 Max. :1023 Max. :1.00 Max. :-1420

> Stan\_summary\_lp\_\_ <- summary(stan\_samples, pars = c("lp\_\_"), probs = c(0.025, 0.975))$summary # sigmasq\_delta entspricht sd, nachher ändern

> Stan\_summary\_lp\_\_

mean se\_mean sd 2.5% 97.5% n\_eff Rhat

lp\_\_ 5348.44 0.01623782 4.284667 5339.162 5355.911 69627.18 1.000101

> # weitere Möglichkeit: Package 'shinystan'

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> # manuelle Berechnung von pD ----------------------------------------------

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> SingeValues\_dev <- summary(stan\_samples, pars = c("dev[1]", "dev[2]", "dev[3]", "dev[4]", "dev[5]", "dev[6]", "dev[7]", "dev[8]", "dev[9]", "dev[10]", "dev[11]", "dev[12]", "dev[13]", "dev[14]", "dev[15]", "dev[16]", "dev[17]", "dev[18]", "dev[19]", "dev[20]", "dev[21]"))$summary

> out\_lePlo <- capture.output( SingeValues\_dev)

> cat("Hilf\_pD", out\_lePlo, file="Hilf\_pD.txt", sep="\n", append=TRUE)

> Hilf\_dev\_pD <- read.table("Hilf\_pD.txt", sep = "", header=F, skip=2, nrows=21)

> #dev ist Std-Abweichung jedes einzelnen Werts

> # insg 21 Werte

> Var\_manuell <- sum(Hilf\_dev\_pD[,2])^2/21

> Var\_manuell

[1] 114.9369

> pD\_manuell <- Var\_manuell/2

> pD\_manuell

[1] 57.46845

>

>

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> ########## ########## ########## Simulation beendet ########## ########## ##########