

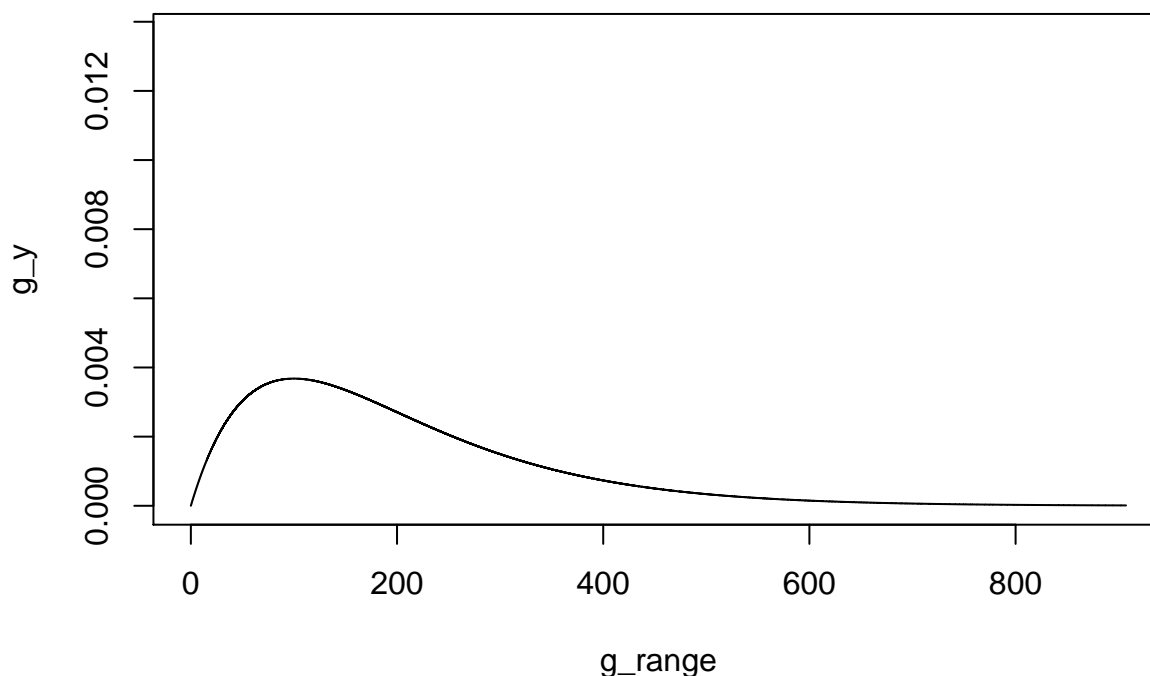
Version 2: 4 clusters; Fix cluster label switching u,v; unif; fix w,theta [0.05,1]

Simulate data

```
I <- 50
K <- 4
S <- 10

# choose diffuse priors for gamma
a_gamma <- 2
b_gamma <- 100

avrg <- a_gamma * b_gamma
std.dv <- sqrt(a_gamma*b_gamma^2)
g_range = seq(0, avrg + 5*std.dv, 0.01)
g_y = dgamma(g_range, a_gamma, rate = 1/b_gamma)
plot(g_range, g_y, type = "l", ylim=c(0, max(g_y) + 0.01))
```



```
set.seed(123)

a <- matrix(NA, nrow=K, ncol=S)
b <- matrix(NA, nrow=K, ncol=S)
for (s in 1:S) {
  a[, s] <- rgamma(K, a_gamma, rate = 1/b_gamma)
  b[, s] <- rgamma(K, a_gamma, rate = 1/b_gamma)
}

pi <- as.vector(rdirichlet(1, rep(1, K)))
```

```

z <- sample(1:K, size = I, replace = T, prob = pi)

w <- matrix(NA, nrow=I, ncol=S)
for (s in 1:S) {
  w[, s] <- rbeta(I, a[,s][z], b[,s][z])
}

tcn <- matrix(2, nrow=I, ncol=S)
m <- matrix(rep(sample(1:2, size = I, replace = T), S), nrow=I, ncol=S)

calcTheta <- function(m, tcn, w) {
  (m * w) / (tcn * w + 2*(1-w))
}
theta <- calcTheta(m, tcn, w)

n <- replicate(S, rpois(I, 100))
y <- matrix(NA, nrow=I, ncol=S)
for (i in 1:I) {
  for (s in 1:S) {
    y[i, s] <- rbinom(1, n[i, s], theta[i,s])
  }
}

```

JAGS

```

jags.file <- file.path(models.dir, "v3_uv_unif.jags")

test.data <- list("I" = I, "S" = S, "K" = K,
                 "y" = y, "n" = n,
                 "m" = m, "tcn" = tcn)
jags.m <- jags.model(jags.file, test.data,
                    n.chains = 1,
                    inits = list(".RNG.name" = "base::Wichmann-Hill",
                                  ".RNG.seed" = 123))

```

```

## Compiling model graph
##   Resolving undeclared variables
##   Allocating nodes
## Graph information:
##   Observed stochastic nodes: 500
##   Unobserved stochastic nodes: 631
##   Total graph size: 8511
##
## Initializing model

```

```

params <- c("z", "w", "U", "V")
samps <- coda.samples(jags.m, params, n.iter=5000, thin=5)
s <- summary(samps)
effectiveSize(samps)

```

```

##      U[1,1]      U[2,1]      U[3,1]      U[4,1]      U[1,2]      U[2,2]
## 793.44518  939.34620  57.91642  63.76809 1000.00000  837.84841
##      U[3,2]      U[4,2]      U[1,3]      U[2,3]      U[3,3]      U[4,3]

```

##	846.88150	885.52021	850.57952	714.95114	868.99274	1000.00000
##	U[1,4]	U[2,4]	U[3,4]	U[4,4]	U[1,5]	U[2,5]
##	824.59520	876.82343	787.88978	823.64806	1000.00000	676.15497
##	U[3,5]	U[4,5]	U[1,6]	U[2,6]	U[3,6]	U[4,6]
##	1000.00000	1000.00000	865.40430	759.38265	1000.00000	1000.00000
##	U[1,7]	U[2,7]	U[3,7]	U[4,7]	U[1,8]	U[2,8]
##	711.70187	730.88693	750.56583	845.43013	893.68149	825.15984
##	U[3,8]	U[4,8]	U[1,9]	U[2,9]	U[3,9]	U[4,9]
##	848.03108	1000.00000	1000.00000	753.24624	809.53324	795.01950
##	U[1,10]	U[2,10]	U[3,10]	U[4,10]	V[1,1]	V[2,1]
##	865.52145	703.69252	1000.00000	1013.60138	902.95819	706.49955
##	V[3,1]	V[4,1]	V[1,2]	V[2,2]	V[3,2]	V[4,2]
##	176.75236	568.91480	697.93154	861.63181	777.67902	870.29221
##	V[1,3]	V[2,3]	V[3,3]	V[4,3]	V[1,4]	V[2,4]
##	912.16804	665.04078	852.70402	885.03103	860.51214	831.11478
##	V[3,4]	V[4,4]	V[1,5]	V[2,5]	V[3,5]	V[4,5]
##	710.86380	1000.00000	900.16281	697.10449	802.48617	912.58513
##	V[1,6]	V[2,6]	V[3,6]	V[4,6]	V[1,7]	V[2,7]
##	672.76356	729.47396	1000.00000	860.99557	1246.95367	669.25770
##	V[3,7]	V[4,7]	V[1,8]	V[2,8]	V[3,8]	V[4,8]
##	1000.00000	891.41228	792.69235	805.67296	874.14970	1000.00000
##	V[1,9]	V[2,9]	V[3,9]	V[4,9]	V[1,10]	V[2,10]
##	828.54925	865.68236	1175.42805	1171.93618	859.18312	690.77022
##	V[3,10]	V[4,10]	w[1,1]	w[2,1]	w[3,1]	w[4,1]
##	1000.00000	1000.00000	1000.00000	1000.00000	851.34367	1000.00000
##	w[5,1]	w[6,1]	w[7,1]	w[8,1]	w[9,1]	w[10,1]
##	1000.00000	746.91050	776.38267	901.50398	1000.00000	1000.00000
##	w[11,1]	w[12,1]	w[13,1]	w[14,1]	w[15,1]	w[16,1]
##	1000.00000	1000.00000	1000.00000	1000.00000	896.80830	1000.00000
##	w[17,1]	w[18,1]	w[19,1]	w[20,1]	w[21,1]	w[22,1]
##	479.22497	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000
##	w[23,1]	w[24,1]	w[25,1]	w[26,1]	w[27,1]	w[28,1]
##	1000.00000	1000.00000	1000.00000	970.61684	820.85860	1000.00000
##	w[29,1]	w[30,1]	w[31,1]	w[32,1]	w[33,1]	w[34,1]
##	1000.00000	1000.00000	854.47331	903.78513	1000.00000	1000.00000
##	w[35,1]	w[36,1]	w[37,1]	w[38,1]	w[39,1]	w[40,1]
##	1046.86914	910.56911	1000.00000	1571.18154	1000.00000	1000.00000
##	w[41,1]	w[42,1]	w[43,1]	w[44,1]	w[45,1]	w[46,1]
##	1000.00000	1000.00000	882.71675	1000.00000	1000.00000	913.28861
##	w[47,1]	w[48,1]	w[49,1]	w[50,1]	w[1,2]	w[2,2]
##	895.42757	1000.00000	1000.00000	1000.00000	1362.62230	909.50091
##	w[3,2]	w[4,2]	w[5,2]	w[6,2]	w[7,2]	w[8,2]
##	837.24215	1000.00000	1000.00000	1000.00000	1000.00000	808.37481
##	w[9,2]	w[10,2]	w[11,2]	w[12,2]	w[13,2]	w[14,2]
##	1000.00000	1000.00000	1000.00000	883.96928	901.28172	900.15815
##	w[15,2]	w[16,2]	w[17,2]	w[18,2]	w[19,2]	w[20,2]
##	1181.55206	899.02564	1000.00000	1000.00000	1203.65242	1000.00000
##	w[21,2]	w[22,2]	w[23,2]	w[24,2]	w[25,2]	w[26,2]
##	1129.95182	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000
##	w[27,2]	w[28,2]	w[29,2]	w[30,2]	w[31,2]	w[32,2]
##	1000.00000	1000.00000	881.85849	899.96438	1000.00000	1000.00000
##	w[33,2]	w[34,2]	w[35,2]	w[36,2]	w[37,2]	w[38,2]
##	1264.48916	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000
##	w[39,2]	w[40,2]	w[41,2]	w[42,2]	w[43,2]	w[44,2]

##	912.51491	1000.00000	909.53683	1000.00000	1000.00000	1000.00000
##	w[45,2]	w[46,2]	w[47,2]	w[48,2]	w[49,2]	w[50,2]
##	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000
##	w[1,3]	w[2,3]	w[3,3]	w[4,3]	w[5,3]	w[6,3]
##	910.59532	1000.00000	1000.00000	1114.74952	883.96721	1000.00000
##	w[7,3]	w[8,3]	w[9,3]	w[10,3]	w[11,3]	w[12,3]
##	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000
##	w[13,3]	w[14,3]	w[15,3]	w[16,3]	w[17,3]	w[18,3]
##	1000.00000	1000.00000	1000.00000	1000.00000	872.33670	1000.00000
##	w[19,3]	w[20,3]	w[21,3]	w[22,3]	w[23,3]	w[24,3]
##	1000.00000	964.15209	1000.00000	1000.00000	1000.00000	1000.00000
##	w[25,3]	w[26,3]	w[27,3]	w[28,3]	w[29,3]	w[30,3]
##	838.32793	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000
##	w[31,3]	w[32,3]	w[33,3]	w[34,3]	w[35,3]	w[36,3]
##	1000.00000	1000.00000	882.44178	894.06725	1000.00000	910.51024
##	w[37,3]	w[38,3]	w[39,3]	w[40,3]	w[41,3]	w[42,3]
##	1000.00000	880.67170	874.70622	1000.00000	1000.00000	762.28221
##	w[43,3]	w[44,3]	w[45,3]	w[46,3]	w[47,3]	w[48,3]
##	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000
##	w[49,3]	w[50,3]	w[1,4]	w[2,4]	w[3,4]	w[4,4]
##	876.01320	797.11652	1000.00000	1000.00000	1000.00000	1095.90553
##	w[5,4]	w[6,4]	w[7,4]	w[8,4]	w[9,4]	w[10,4]
##	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000
##	w[11,4]	w[12,4]	w[13,4]	w[14,4]	w[15,4]	w[16,4]
##	1000.00000	876.97476	867.99523	797.98139	1000.00000	1000.00000
##	w[17,4]	w[18,4]	w[19,4]	w[20,4]	w[21,4]	w[22,4]
##	889.51602	799.69081	1000.00000	1000.00000	1000.00000	1000.00000
##	w[23,4]	w[24,4]	w[25,4]	w[26,4]	w[27,4]	w[28,4]
##	1000.00000	1000.00000	1000.00000	1000.00000	853.46933	857.70534
##	w[29,4]	w[30,4]	w[31,4]	w[32,4]	w[33,4]	w[34,4]
##	870.65032	1000.00000	1000.00000	1000.00000	891.26403	889.87496
##	w[35,4]	w[36,4]	w[37,4]	w[38,4]	w[39,4]	w[40,4]
##	874.20925	1000.00000	889.14378	823.29583	1000.00000	481.63250
##	w[41,4]	w[42,4]	w[43,4]	w[44,4]	w[45,4]	w[46,4]
##	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000
##	w[47,4]	w[48,4]	w[49,4]	w[50,4]	w[1,5]	w[2,5]
##	1000.00000	1000.00000	1118.78499	1000.00000	1000.00000	831.51716
##	w[3,5]	w[4,5]	w[5,5]	w[6,5]	w[7,5]	w[8,5]
##	1000.00000	1000.00000	1053.74997	1000.00000	1000.00000	871.97438
##	w[9,5]	w[10,5]	w[11,5]	w[12,5]	w[13,5]	w[14,5]
##	904.71436	1000.00000	1115.05814	1000.00000	910.74954	1000.00000
##	w[15,5]	w[16,5]	w[17,5]	w[18,5]	w[19,5]	w[20,5]
##	1000.00000	1000.00000	1000.00000	1000.00000	851.45694	1000.00000
##	w[21,5]	w[22,5]	w[23,5]	w[24,5]	w[25,5]	w[26,5]
##	819.91711	1042.30947	911.23629	904.19279	1000.00000	1000.00000
##	w[27,5]	w[28,5]	w[29,5]	w[30,5]	w[31,5]	w[32,5]
##	1000.00000	1000.00000	1083.52006	1252.04800	1000.00000	1000.00000
##	w[33,5]	w[34,5]	w[35,5]	w[36,5]	w[37,5]	w[38,5]
##	1000.00000	1035.45052	1000.00000	1000.00000	979.96309	1000.00000
##	w[39,5]	w[40,5]	w[41,5]	w[42,5]	w[43,5]	w[44,5]
##	962.70098	1000.00000	1000.00000	1000.00000	888.32943	1000.00000
##	w[45,5]	w[46,5]	w[47,5]	w[48,5]	w[49,5]	w[50,5]
##	1000.00000	1000.00000	1193.18947	1115.17980	1000.00000	1000.00000
##	w[1,6]	w[2,6]	w[3,6]	w[4,6]	w[5,6]	w[6,6]

##	1000.00000	1000.00000	911.42246	812.98366	1000.00000	1000.00000
##	w[7,6]	w[8,6]	w[9,6]	w[10,6]	w[11,6]	w[12,6]
##	889.18224	1000.00000	1000.00000	896.32911	1000.00000	1000.00000
##	w[13,6]	w[14,6]	w[15,6]	w[16,6]	w[17,6]	w[18,6]
##	1000.00000	962.49913	958.92263	1000.00000	1000.00000	791.42400
##	w[19,6]	w[20,6]	w[21,6]	w[22,6]	w[23,6]	w[24,6]
##	886.98861	816.48511	727.52664	854.44361	1000.00000	1000.00000
##	w[25,6]	w[26,6]	w[27,6]	w[28,6]	w[29,6]	w[30,6]
##	1000.00000	1000.00000	1000.00000	1000.00000	855.99037	874.36221
##	w[31,6]	w[32,6]	w[33,6]	w[34,6]	w[35,6]	w[36,6]
##	1000.00000	1000.00000	852.49776	1000.00000	1000.00000	1000.00000
##	w[37,6]	w[38,6]	w[39,6]	w[40,6]	w[41,6]	w[42,6]
##	1000.00000	1087.37688	1000.00000	1000.00000	1000.00000	1000.00000
##	w[43,6]	w[44,6]	w[45,6]	w[46,6]	w[47,6]	w[48,6]
##	1450.63083	1000.00000	1267.40233	1095.41568	1000.00000	1000.00000
##	w[49,6]	w[50,6]	w[1,7]	w[2,7]	w[3,7]	w[4,7]
##	1000.00000	1000.00000	1000.00000	884.25212	1000.00000	1000.00000
##	w[5,7]	w[6,7]	w[7,7]	w[8,7]	w[9,7]	w[10,7]
##	1588.27463	1000.00000	1000.00000	1000.00000	883.73366	1000.00000
##	w[11,7]	w[12,7]	w[13,7]	w[14,7]	w[15,7]	w[16,7]
##	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000
##	w[17,7]	w[18,7]	w[19,7]	w[20,7]	w[21,7]	w[22,7]
##	894.02183	835.21389	1000.00000	1000.00000	1000.00000	1000.00000
##	w[23,7]	w[24,7]	w[25,7]	w[26,7]	w[27,7]	w[28,7]
##	1000.00000	1000.00000	1000.00000	1518.25192	1218.33909	1000.00000
##	w[29,7]	w[30,7]	w[31,7]	w[32,7]	w[33,7]	w[34,7]
##	1000.00000	1091.99326	1000.00000	1174.97187	997.46185	1000.00000
##	w[35,7]	w[36,7]	w[37,7]	w[38,7]	w[39,7]	w[40,7]
##	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000	1247.83638
##	w[41,7]	w[42,7]	w[43,7]	w[44,7]	w[45,7]	w[46,7]
##	1000.00000	1000.00000	1252.54493	1000.00000	1000.00000	1350.57226
##	w[47,7]	w[48,7]	w[49,7]	w[50,7]	w[1,8]	w[2,8]
##	1000.00000	1000.00000	1000.00000	1090.09415	1000.00000	1000.00000
##	w[3,8]	w[4,8]	w[5,8]	w[6,8]	w[7,8]	w[8,8]
##	821.40637	1000.00000	1219.96313	1000.00000	1000.00000	543.65396
##	w[9,8]	w[10,8]	w[11,8]	w[12,8]	w[13,8]	w[14,8]
##	1534.43989	1459.73797	1000.00000	1000.00000	1000.00000	1000.00000
##	w[15,8]	w[16,8]	w[17,8]	w[18,8]	w[19,8]	w[20,8]
##	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000	1000.00000
##	w[21,8]	w[22,8]	w[23,8]	w[24,8]	w[25,8]	w[26,8]
##	1000.00000	1000.00000	911.08044	1180.92969	910.84694	1000.00000
##	w[27,8]	w[28,8]	w[29,8]	w[30,8]	w[31,8]	w[32,8]
##	1000.00000	1000.00000	1000.00000	912.27418	1000.00000	1000.00000
##	w[33,8]	w[34,8]	w[35,8]	w[36,8]	w[37,8]	w[38,8]
##	1000.00000	1000.00000	986.04260	1000.00000	1000.00000	1184.39090
##	w[39,8]	w[40,8]	w[41,8]	w[42,8]	w[43,8]	w[44,8]
##	1000.00000	1000.00000	1144.49527	1098.49860	812.96164	1000.00000
##	w[45,8]	w[46,8]	w[47,8]	w[48,8]	w[49,8]	w[50,8]
##	1000.00000	1024.78196	1000.00000	1000.00000	1000.00000	1000.00000
##	w[1,9]	w[2,9]	w[3,9]	w[4,9]	w[5,9]	w[6,9]
##	1198.23559	1000.00000	1000.00000	1000.00000	1143.73641	659.24031
##	w[7,9]	w[8,9]	w[9,9]	w[10,9]	w[11,9]	w[12,9]
##	1000.00000	835.37531	1153.61355	1000.00000	1172.88949	1309.75494
##	w[13,9]	w[14,9]	w[15,9]	w[16,9]	w[17,9]	w[18,9]

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## 904.51794 1000.00000 1000.00000 1000.00000 1000.00000 880.26509
## w[19,9] w[20,9] w[21,9] w[22,9] w[23,9] w[24,9]
## 1000.00000 1000.00000 1000.00000 1000.00000 1000.00000 1096.13575
## w[25,9] w[26,9] w[27,9] w[28,9] w[29,9] w[30,9]
## 1066.98478 951.70709 1000.00000 1000.00000 969.41398 1000.00000
## w[31,9] w[32,9] w[33,9] w[34,9] w[35,9] w[36,9]
## 1000.00000 1000.00000 890.09811 1000.00000 1000.00000 1391.37670
## w[37,9] w[38,9] w[39,9] w[40,9] w[41,9] w[42,9]
## 715.17623 1163.97423 1000.00000 1000.00000 1000.00000 1000.00000
## w[43,9] w[44,9] w[45,9] w[46,9] w[47,9] w[48,9]
## 1000.00000 1000.00000 1000.00000 1005.67781 964.82754 1000.00000
## w[49,9] w[50,9] w[1,10] w[2,10] w[3,10] w[4,10]
## 1000.00000 1000.00000 1136.53757 1000.00000 1000.00000 1000.00000
## w[5,10] w[6,10] w[7,10] w[8,10] w[9,10] w[10,10]
## 826.77955 876.87062 1050.57962 1000.00000 1000.00000 1000.00000
## w[11,10] w[12,10] w[13,10] w[14,10] w[15,10] w[16,10]
## 907.22935 992.67979 1000.00000 1000.00000 1000.00000 1120.37093
## w[17,10] w[18,10] w[19,10] w[20,10] w[21,10] w[22,10]
## 1000.00000 910.02790 907.18337 1000.00000 886.72373 892.43982
## w[23,10] w[24,10] w[25,10] w[26,10] w[27,10] w[28,10]
## 1000.00000 1000.00000 1000.00000 1000.00000 1000.00000 1000.00000
## w[29,10] w[30,10] w[31,10] w[32,10] w[33,10] w[34,10]
## 1000.00000 1000.00000 1000.00000 1000.00000 1405.72450 1000.00000
## w[35,10] w[36,10] w[37,10] w[38,10] w[39,10] w[40,10]
## 1000.00000 1000.00000 1000.00000 1000.00000 771.10720 899.10560
## w[41,10] w[42,10] w[43,10] w[44,10] w[45,10] w[46,10]
## 1106.36345 1000.00000 1000.00000 909.19108 1000.00000 1095.26330
## w[47,10] w[48,10] w[49,10] w[50,10] z[1] z[2]
## 1000.00000 906.72435 1000.00000 1000.00000 0.00000 0.00000
## z[3] z[4] z[5] z[6] z[7] z[8]
## 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
## z[9] z[10] z[11] z[12] z[13] z[14]
## 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
## z[15] z[16] z[17] z[18] z[19] z[20]
## 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
## z[21] z[22] z[23] z[24] z[25] z[26]
## 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
## z[27] z[28] z[29] z[30] z[31] z[32]
## 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
## z[33] z[34] z[35] z[36] z[37] z[38]
## 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
## z[39] z[40] z[41] z[42] z[43] z[44]
## 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
## z[45] z[46] z[47] z[48] z[49] z[50]
## 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000

```

```

pdf(file.path(trace.dir, paste0(runName, "_trace.pdf")))
plot(samps)
dev.off()

```

```

## pdf
## 2

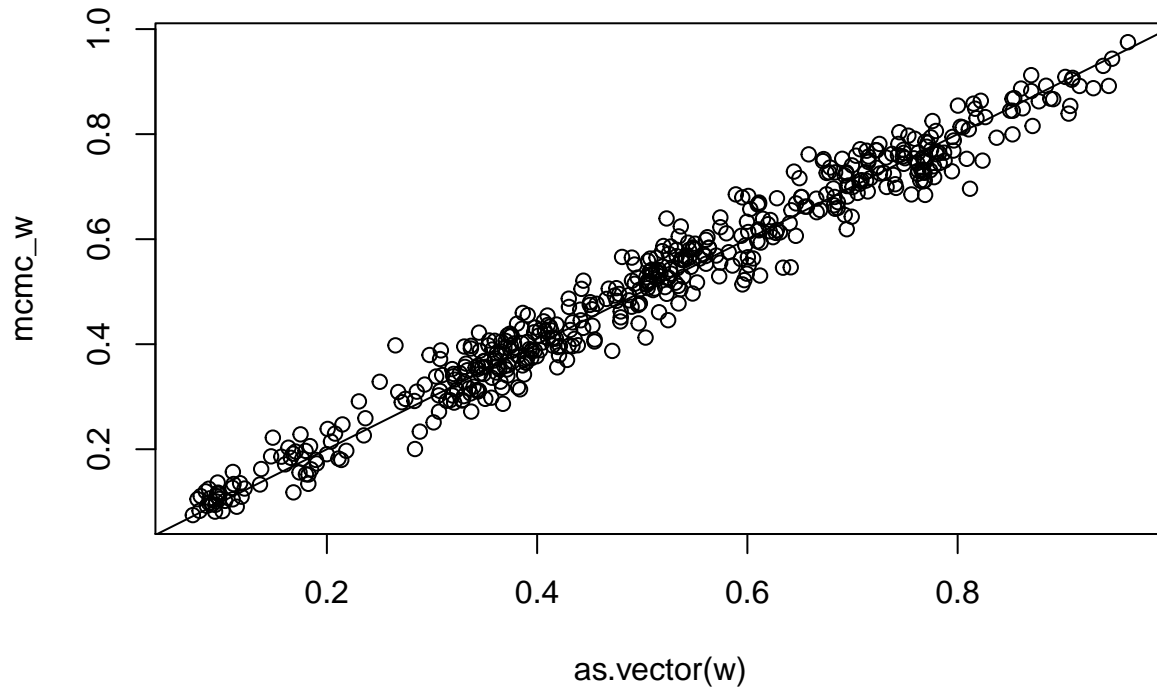
```

```

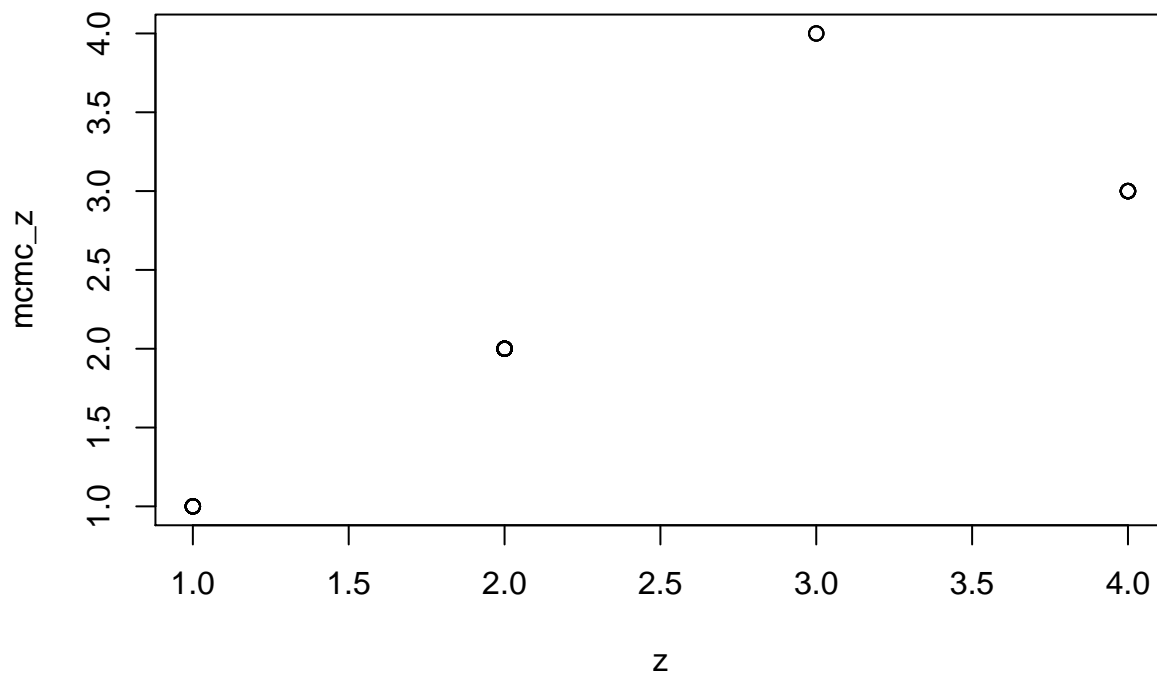
mcmc_vals <- s$statistics
mcmc_w <- mcmc_vals[substr(rownames(mcmc_vals), 1, 1) == "w", "Mean"]

```

```
plot(as.vector(w), mcmc_w, type = "p")
abline(a=0, b=1)
```



```
mcmc_z <- as.vector(mcmc_vals[substr(rownames(mcmc_vals), 1, 1) == "z", "Mean"])
#mcmc_z <- round(mcmc_z, 0)
plot(z, mcmc_z, type = "p")
```



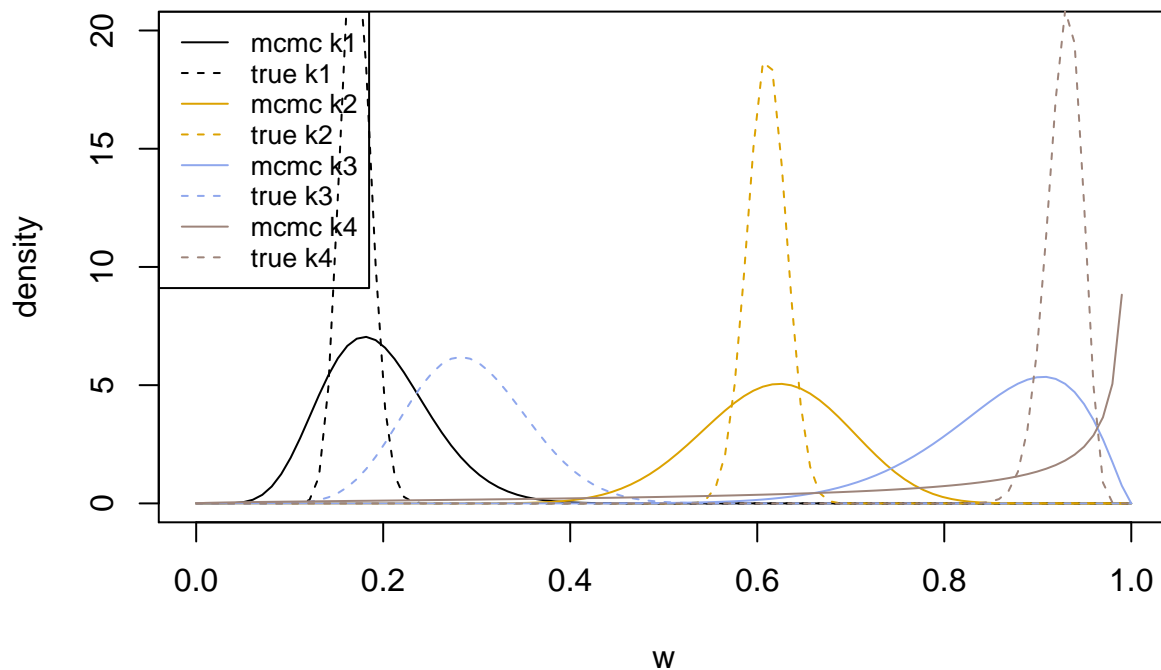
```
mcmc_U <- mcmc_vals[substr(rownames(mcmc_vals), 1, 1) == "U", "Mean"]
mcmc_U <- matrix(mcmc_U, nrow=K)
mcmc_V <- mcmc_vals[substr(rownames(mcmc_vals), 1, 1) == "V", "Mean"]
mcmc_V <- matrix(mcmc_V, nrow=K)
```

```

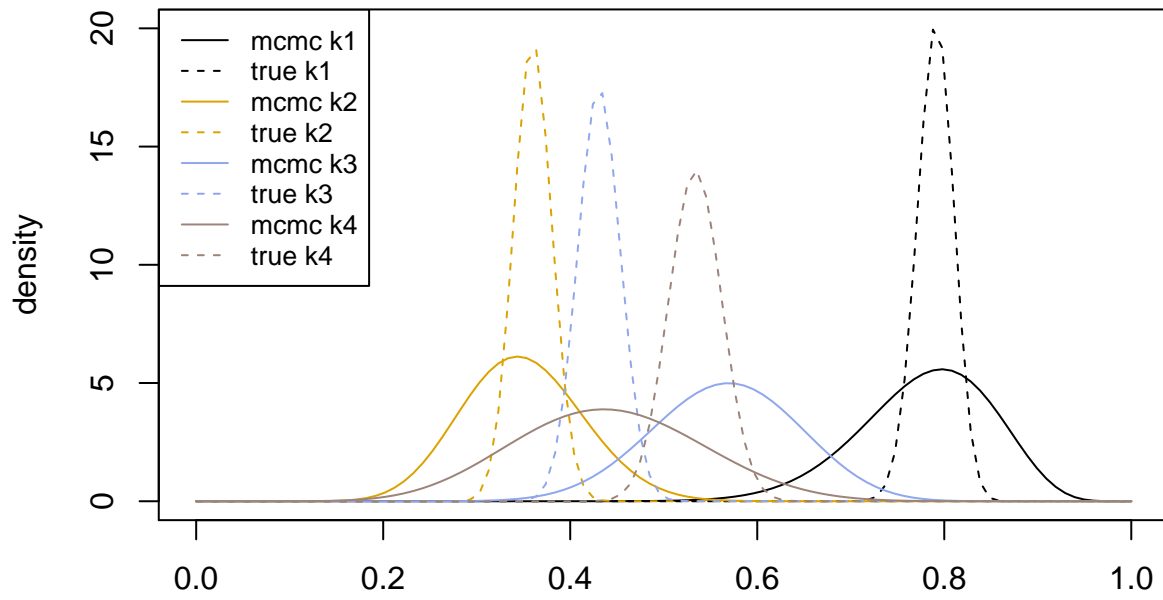
p <- seq(0, 1, length = 100)
colors <- c("#000000", "#DCA200", "#8FA7ED", "#9D847A", "#A47901")
for (s in 1:S) {
  for (k in 1:K) {
    if (k == 1) {
      # plot mcmc mean U,V
      plot(p, dbeta(p, mcmc_U[k,s] * mcmc_V[k,s], (1-mcmc_U[k,s])*mcmc_V[k,s]),
           main = paste0("S", s),
           ylab = "density", xlab = "w", type = "l", col = colors[k],
           ylim = c(0, 20))
      # plot truth
      lines(p, dbeta(p, a[k,s], b[k,s]), type = "l", col = colors[k], lty=2)
      # add legend
      legend(x = "topleft",
             legend = paste0(c("mcmc k", "true k"), rep(1:K, each=2)),
             col = colors[rep(1:K, each=2)],
             lty = rep(1:2, K),
             cex=0.8)
    } else {
      # plot mcmc mean U,V
      lines(p, dbeta(p, mcmc_U[k,s] * mcmc_V[k,s], (1-mcmc_U[k,s])*mcmc_V[k,s]),
            type = "l", col = colors[k])
      # plot truth
      lines(p, dbeta(p, a[k,s], b[k,s]), type = "l", col = colors[k], lty=2)
    }
  }
}

```

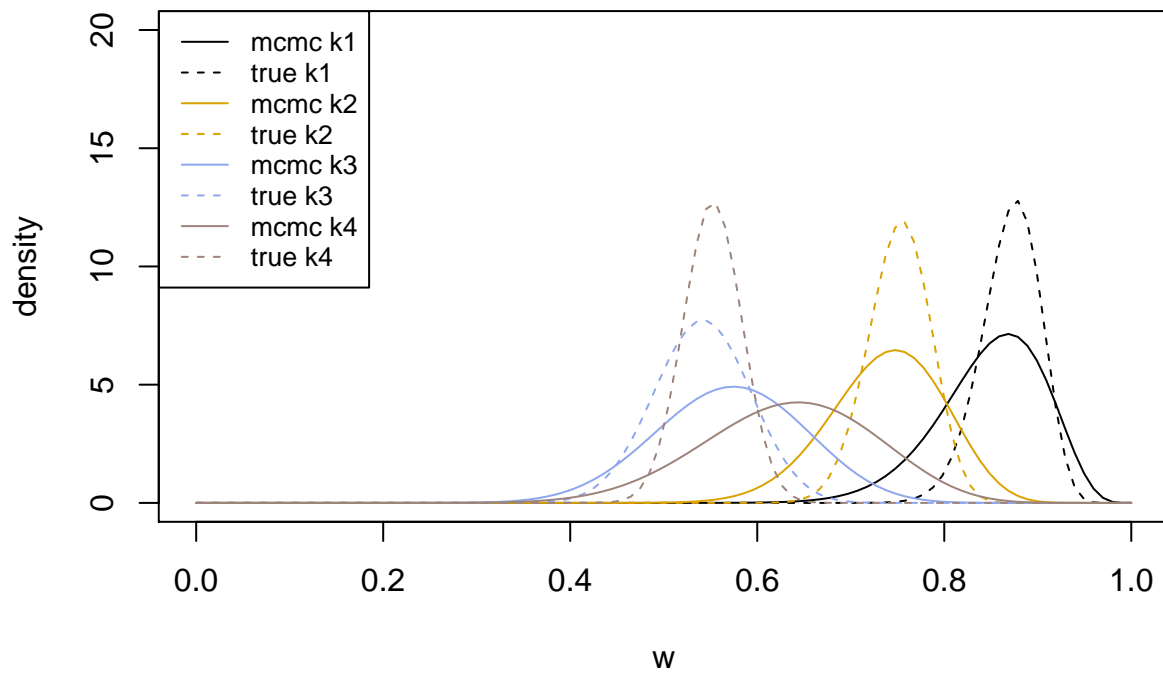
S1



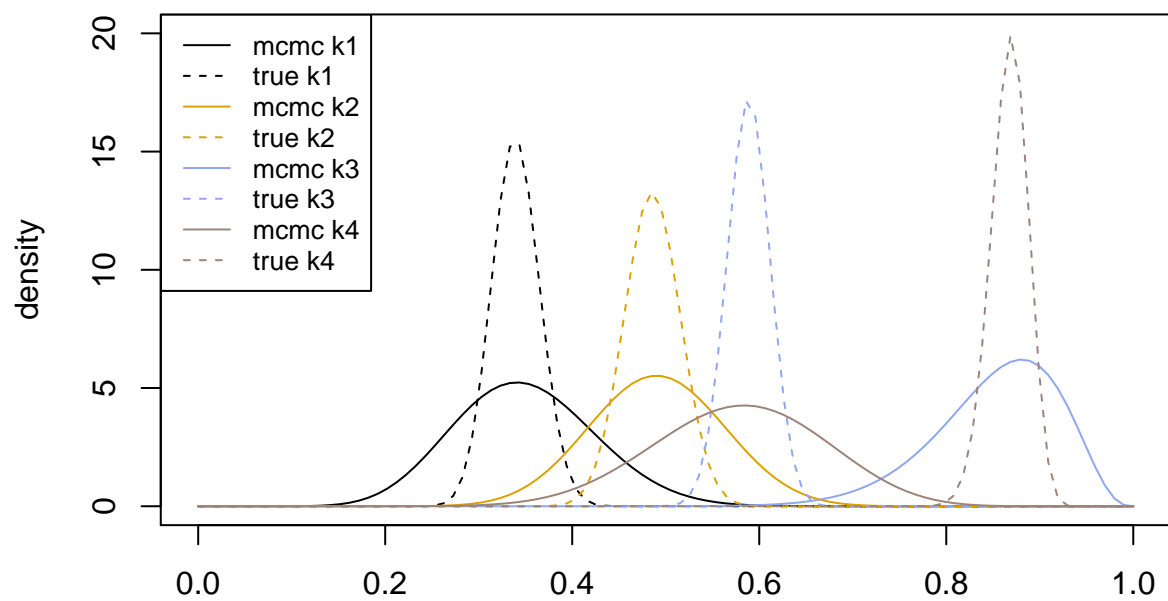
S2



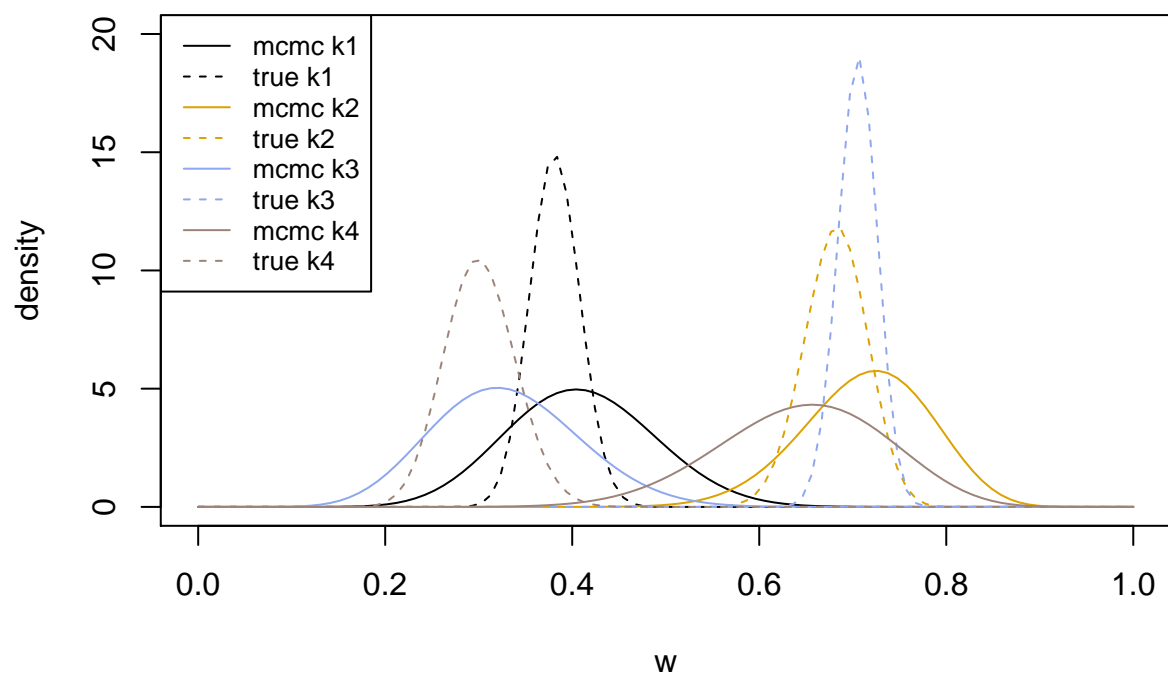
S3



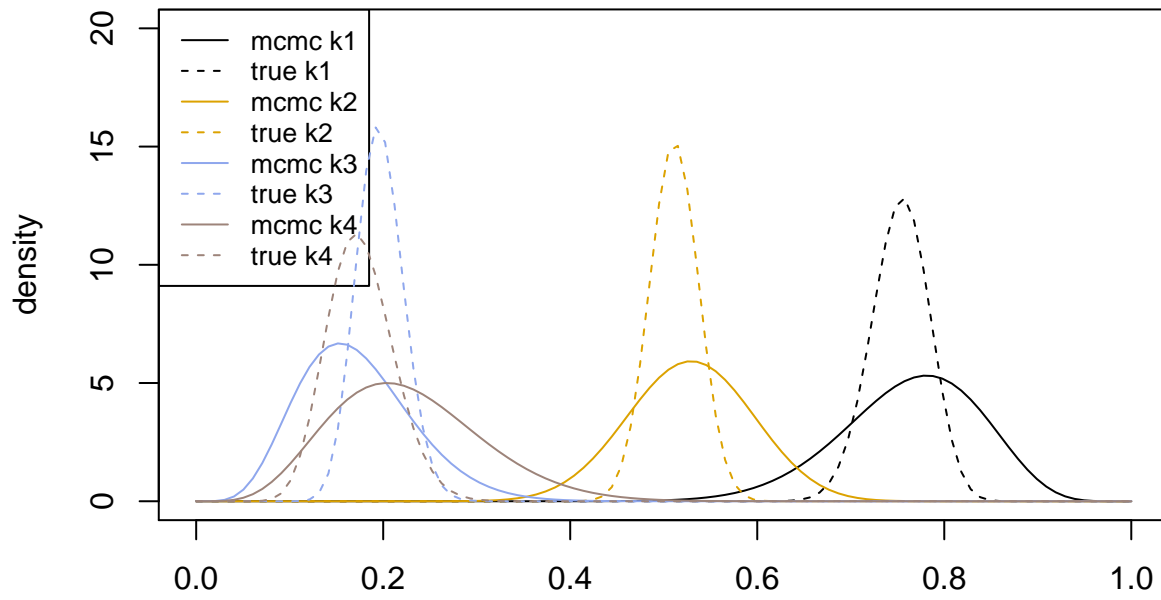
S4



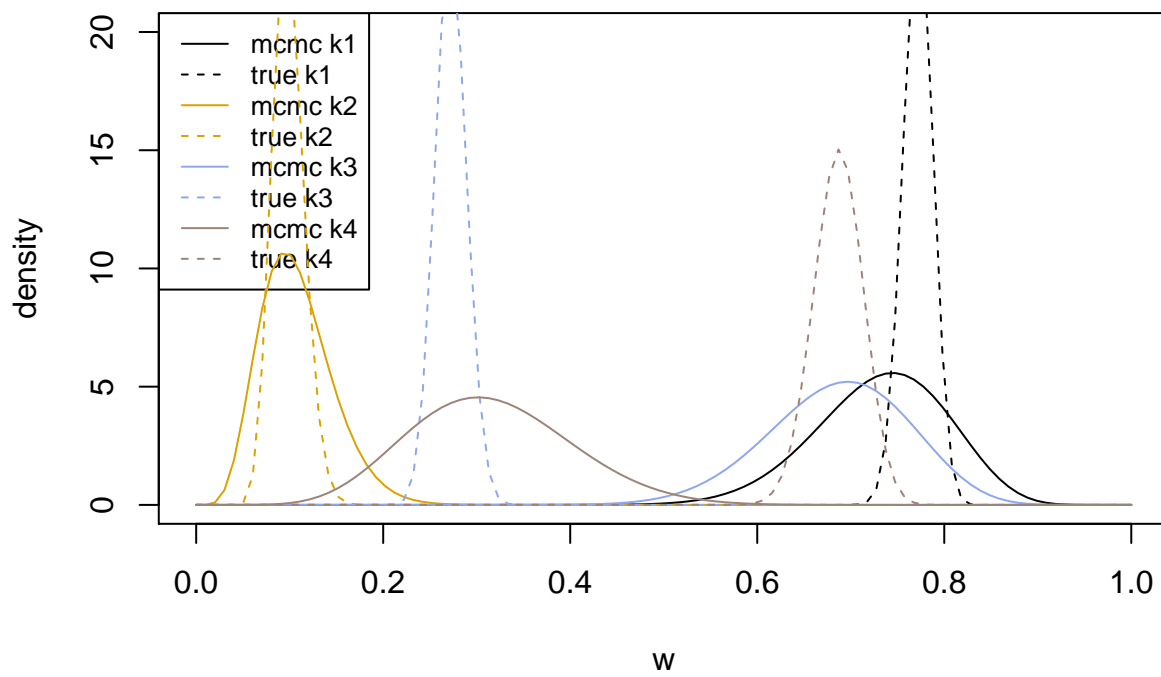
S5



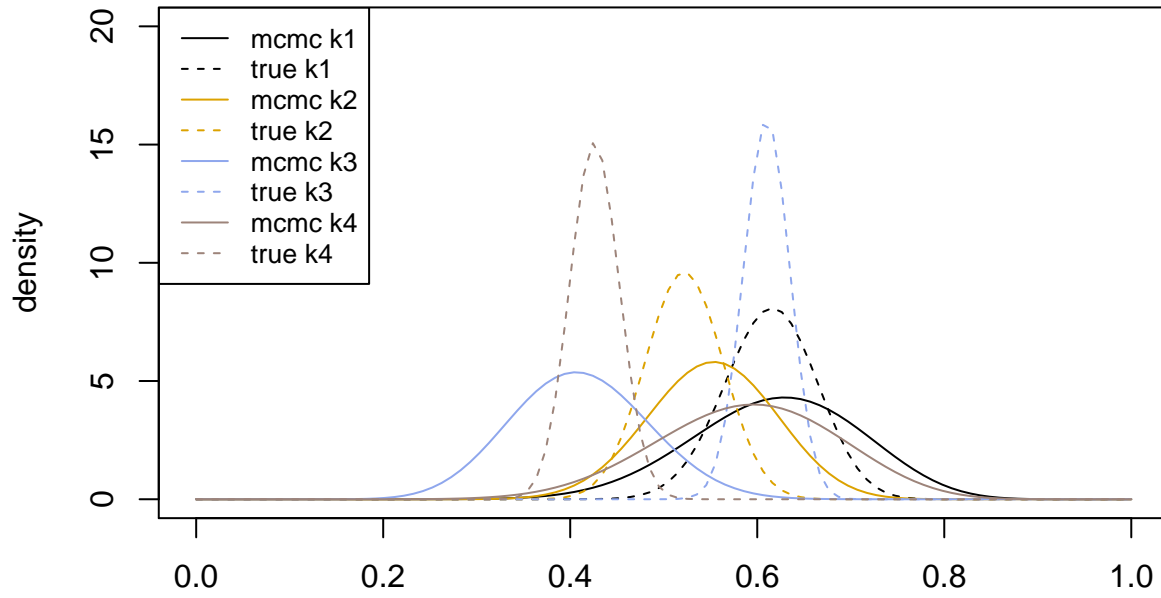
S6



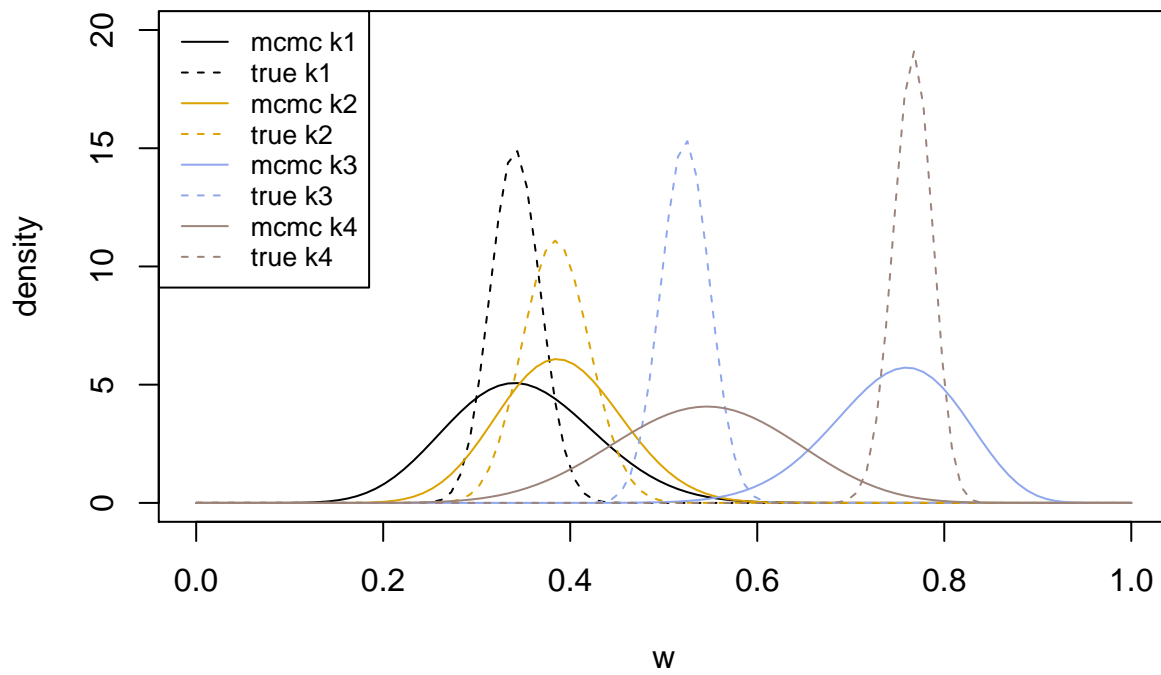
S7



S8



S9



S10

