Testing different imputation methods on PUMS (MAR)

```
# load dataset: df
load('../Datasets/ordinalPUMS.Rdata')

# take 10,000 samples: df
set.seed(0)
n = 10000
sample <- sample(nrow(df), size = 10000)
df <- df[sample,]

# create MCAR scneario with 30% chance of missing: df_observed
missing_prob = 0.3
df_observed <- df
missing_col = c(1,3,7,9,10,11)

# Make VEH and WKL MCAR
missing_col_MCAR = c(1,10)
for (col in missing_col_MCAR) {
  missing_ind <- rbernoulli(n,p = missing_prob)
  df_observed[missing_ind, col] <- NA
}

# Make the rest MAR
numeric_df = sapply(df, as.numeric)
normalized_df = t(t(numeric_df-1)/(apply(numeric_df, MARGIN = 2, FUN = max)-1))
missing_col_MAR = c(3,7,9,11)
fully_observed_col = c(2,4,5,6,8)
beta_NP = c(0, 15, -12, 14, 0)
beta0_NP = -1
beta_SCHL = c(2, -12, 2.5, 0, 0)
beta0_SCHL = -1
beta_AGEP = c(4, 5, 0, -12, 0)
beta0_AGEP = -1
beta_PINCP = c(-12, 0, 4, 4, 0)
beta0_PINCP = -1

# missing probability for NP
prob_NP = apply(t(t(normalized_df[, fully_observed_col])*beta_NP), MARGIN = 1, sum)+beta0_NP
prob_NP = exp(prob_NP)/(exp(prob_NP)+1)
indicator = rbernoulli(n, p = prob_NP)
df_observed[indicator, missing_col_MAR[1]] <- NA

# missing probability for SCHL
prob_SCHL = apply(t(t(normalized_df[, fully_observed_col])*beta_SCHL), MARGIN = 1, sum) + beta0_SCHL
prob_SCHL = exp(prob_SCHL)/(exp(prob_SCHL)+1)
indicator = rbernoulli(n, p = prob_SCHL)
df_observed[indicator, missing_col_MAR[2]] <- NA

# missing probability for AGEP
prob_AGEP = apply(t(t(normalized_df[, fully_observed_col])*beta_AGEP), MARGIN = 1, sum) + beta0_AGEP
```

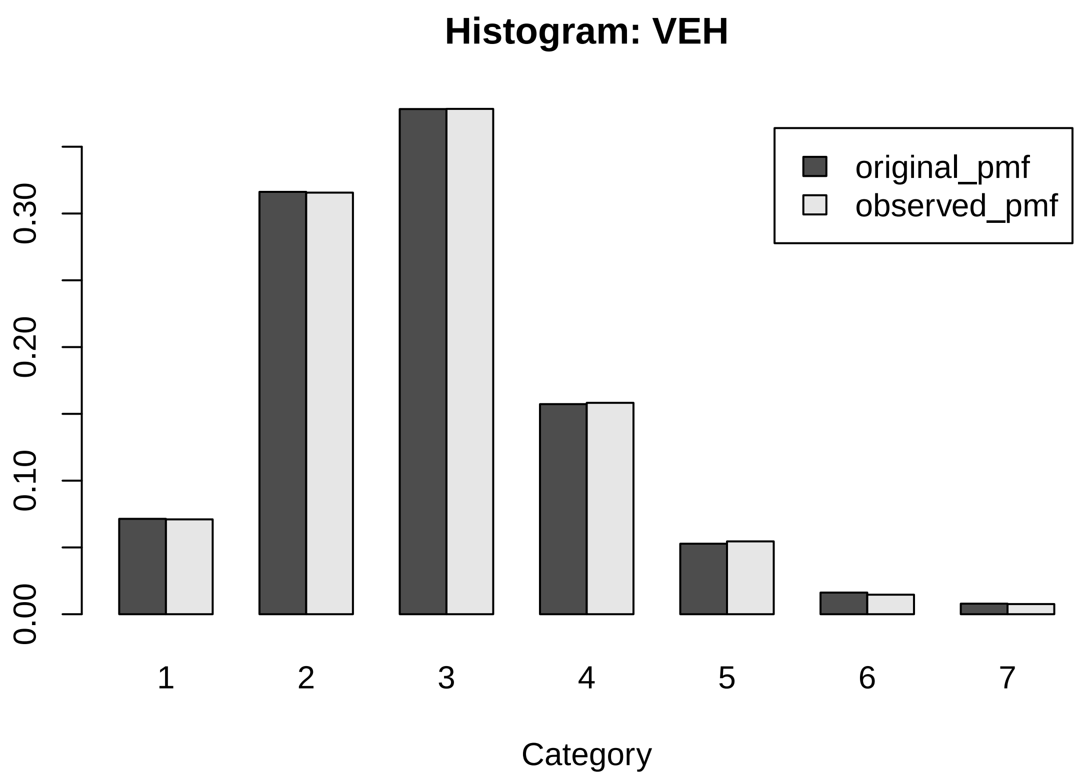
```r
prob_AGEP = exp(prob_AGEP)/(exp(prob_AGEP)+1)
indicator = rbernoulli(n, p = prob_AGEP)
df_observed[indicator, missing_col_MAR[3]] <- NA

# missing probability for PINCP
prob_PINCP = apply(t(t(normalized_df[, fully_observed_col])*beta_PINCP), MARGIN = 1, sum) + beta0_PINCP
prob_PINCP = exp(prob_PINCP)/(exp(prob_PINCP)+1)
indicator = rbernoulli(n, p = prob_PINCP)
df_observed[indicator, missing_col_MAR[4]] <- NA

# 30.61% missing
apply(is.na(df_observed), MARGIN = 2, mean)
```

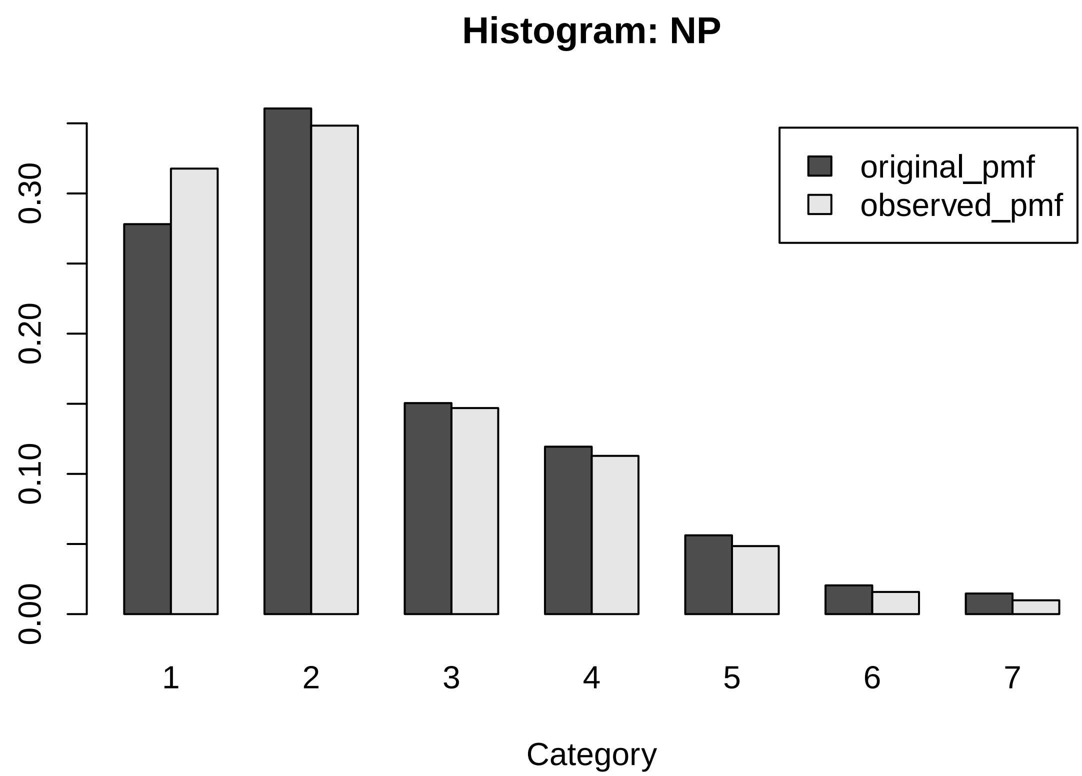
```
##    VEH     MV     NP   RMSP    ENG  MARHT   SCHL RACNUM   AGEP    WKL  PINCP
## 0.3030 0.0000 0.2786 0.0000 0.0000 0.0000 0.3159 0.0000 0.3273 0.3017 0.3101
```

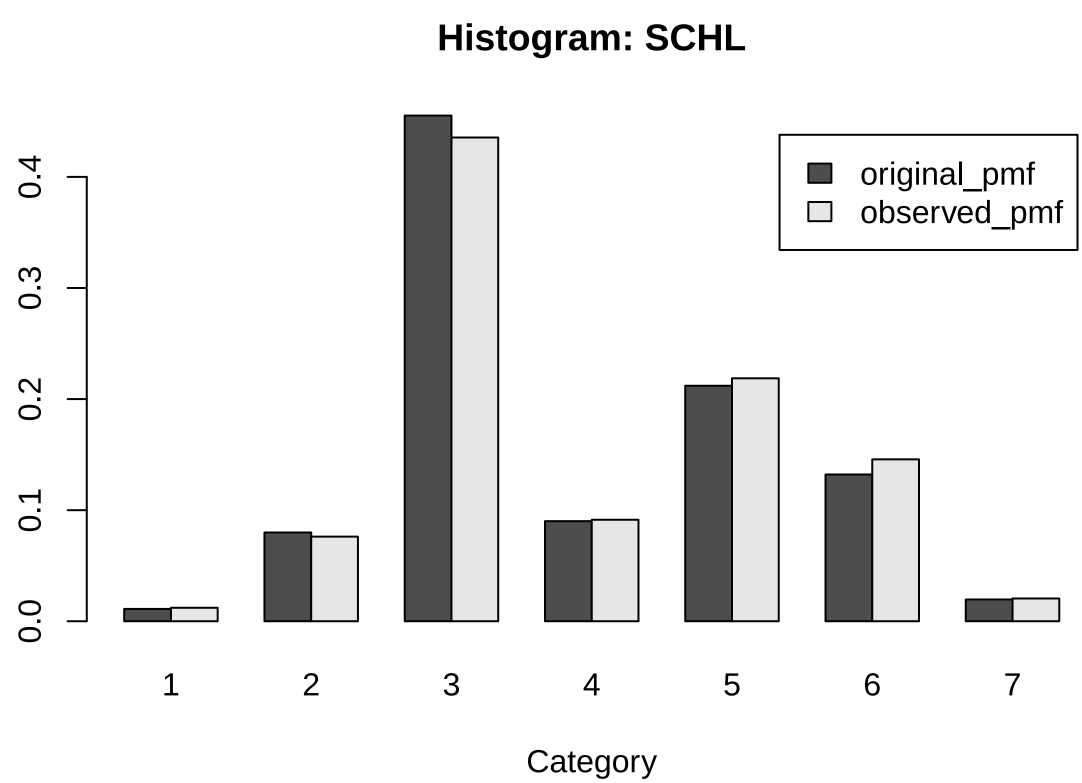
Histogram for univariate distribution

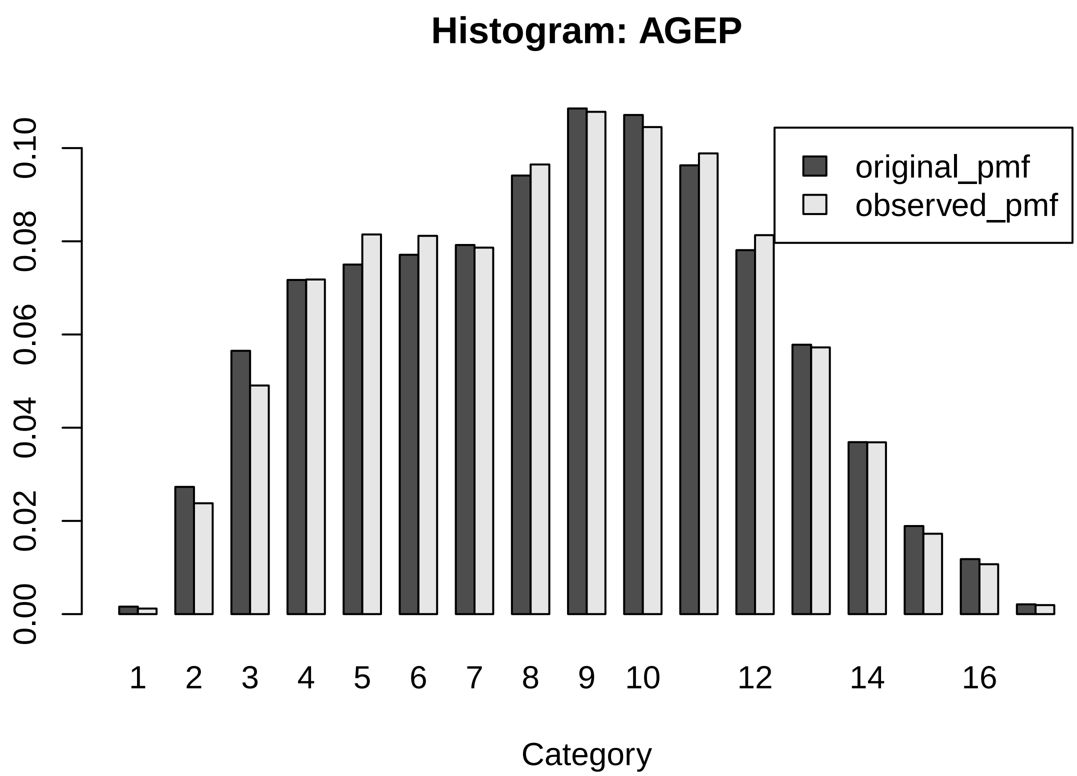


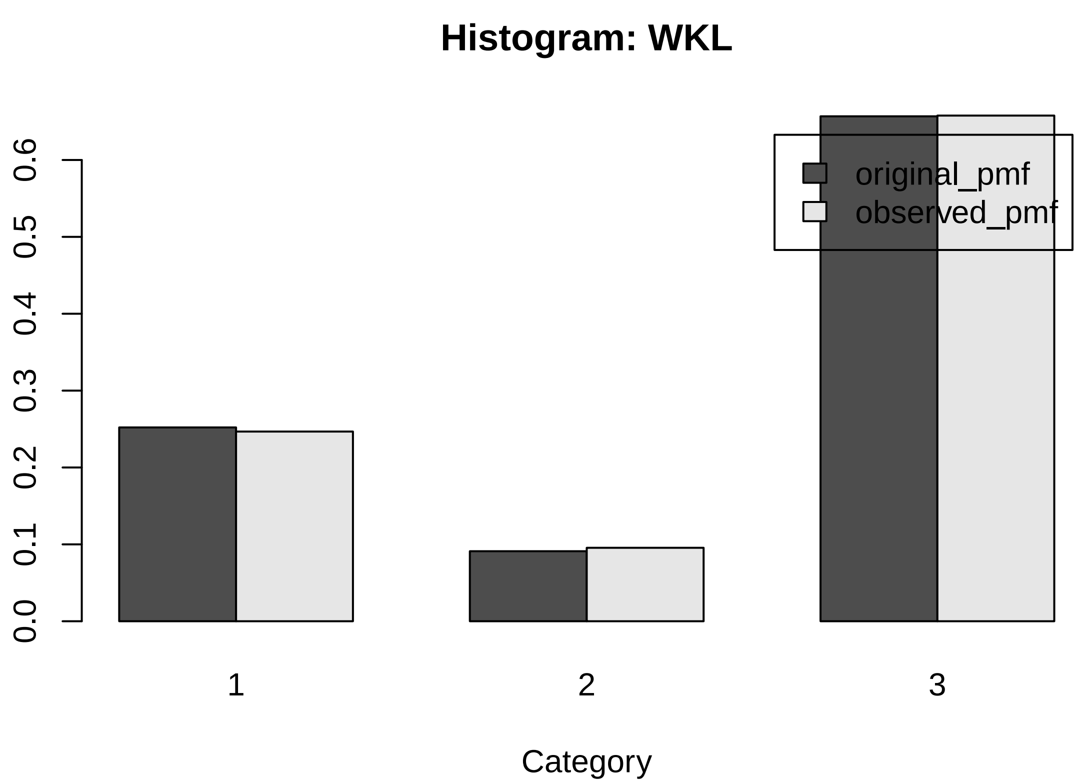
Assess bivariate joint distribution

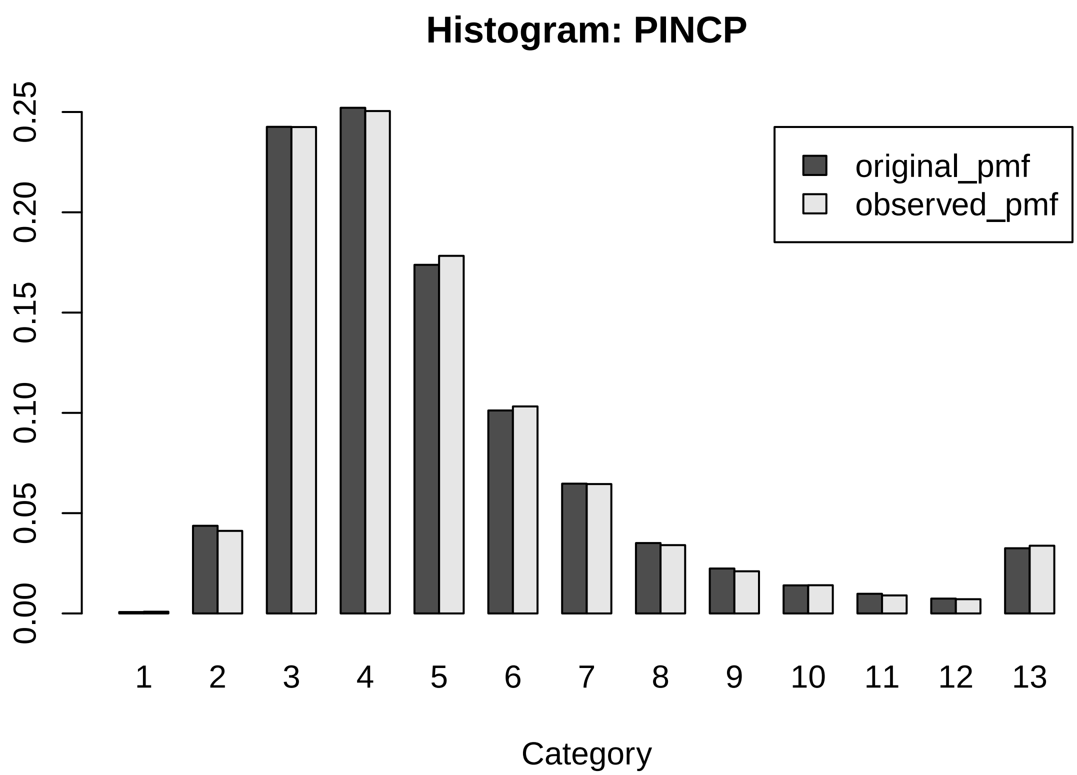
Assess trivariate joint distribution

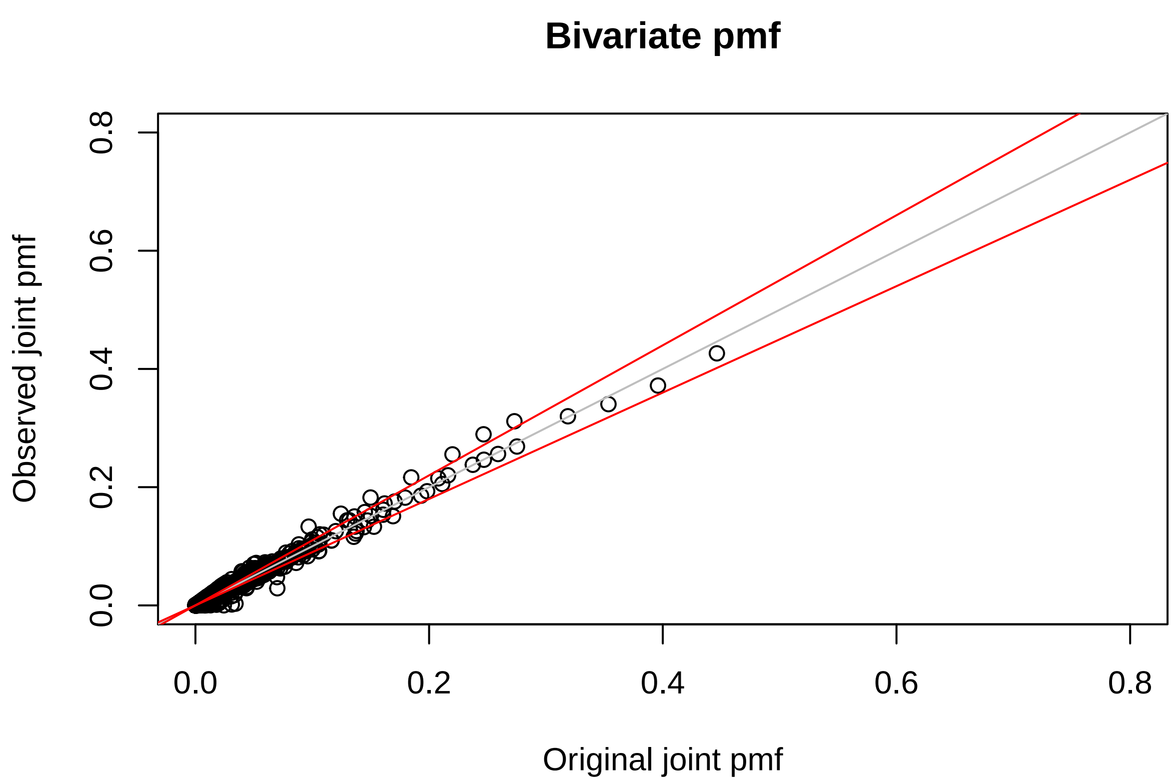

Histogram: NP
original_pmf
observed_pmf
0.00
0.10
0.20
0.30
1
2
3
4
5
6
7
Category

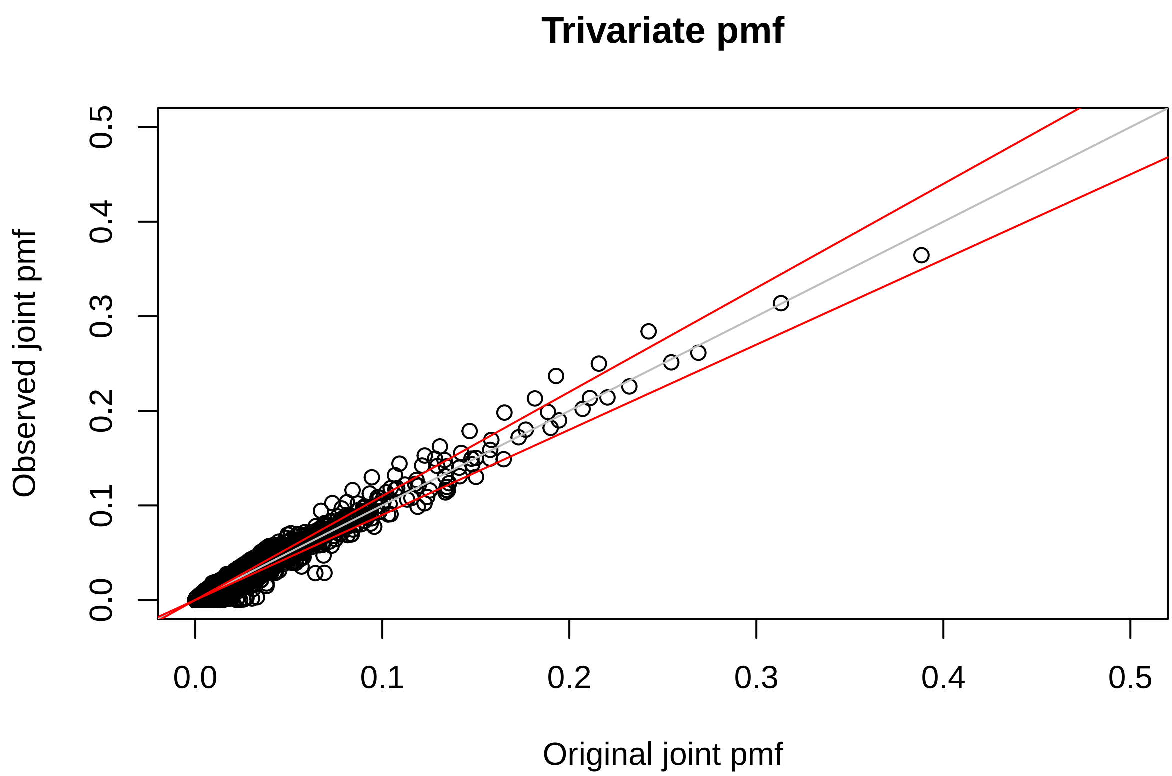

Histogram: SCHL
original_pmf
observed_pmf
0.0
0.1
0.2
0.3
0.4
1
2
3
4
5
6
7
Category


Histogram: AGEP
0.00
0.02
0.04
0.06
0.08
0.10
original_pmf
observed_pmf
1
2
3
4
5
6
7
8
9
10
12
14
16
Category


Histogram: WKL
0.0
0.1
0.2
0.3
0.4
0.5
0.6
original_pmf
observed_pmf
1
2
3
Category


Histogram: PINCP
0.00
0.05
0.10
0.15
0.20
0.25
original_pmf
observed_pmf
1
2
3
4
5
6
7
8
9
10
11
12
13
Category


Bivariate pmf
Observed joint pmf
0.0
0.2
0.4
0.6
0.8
0.0
0.2
0.4
0.6
0.8
Original joint pmf


Trivariate pmf
Observed joint pmf
Original joint pmf
0.0
0.1
0.2
0.3
0.4
0.5