

# MAR 45% missing - DPMPM

```
# sample MCAR dataset from PUMS
source("../utils/sampleMAR45.R")
n = 10000
missing_col = c(1,3,7,9,10,11)
set.seed(3)

output_list <- sampleMAR45(n)
df <- output_list[['df']]
df_observed <- output_list[['df_observed']]

apply(is.na(df_observed), MARGIN = 2, mean)

##      VEH      MV      NP    RMSP      ENG    MARHT    SCHL RACNUM     AGEP      WKL    PINCP
## 0.4456 0.0000 0.3998 0.0000 0.0000 0.0000 0.4842 0.0000 0.4670 0.4478 0.4384
```

## DPMPM

Multiple imputation using NPBayesImputeCat package

Ref: <https://cran.r-project.org/web/packages/NPBayesImputeCat/NPBayesImputeCat.pdf>

1. Create and initialize the Rcpp\_Lcm model object using CreateModel with the following arguments:
  - X: dataframe to be imputed = df
  - MCZ: dataframe with the definition of structural zero = NULL
  - K: the maximum number of mixture components = 40
  - Nmax: An upper truncation limit for the augmented sample size = 0
  - aalpha: the hyper parameter alpha in stick-breaking prior = 0.25
  - balpha: the hyper parameter beta in stick-breaking prior = 0.25
  - seed = 0
2. Set the tracer for the sampling process
  - k\_star: the effective cluster number
  - psi: conditional multinomial probabilities
  - ImputedX: imputation result
3. Run the model using the method Run of Rcpp\_Lcm class with the following arguments:
  - burnin = 10000
  - iter = 10000
  - thinning = 5
4. Obtain result

```
N = 40
Mon = 10000
B = 10000
thin.int = 5

# 1. Create and initialize the Rcpp_Lcm model object
model = CreateModel(X = df_observed, MCZ = NULL, K = N, Nmax = 0,
                     aalpha = 0.25, balpha = 0.25, seed = 0)
# 2. Set tracer
```

```

model$SetTrace(c('k_star', 'psi', 'ImputedX', 'alpha'), Mon)

# 3. Run model using Run(burnin, iter, thinning)
model$Run(B, Mon, thin.int)

# Extract results and format output
output <- model$GetTrace()
k_star <- output$k_star
psi <- output$psi
imputed_df <- output$ImputedX
alpha <- output$alpha

#retrieve parameters from the final iteration
result <- model$snapshot

#convert ImputedX matrix to dataframe, using proper factors/names etc.
ImputedX <- GetDataFrame(result$ImputedX, df)

# extract 5 imputed dataset from DP model
imputation_index = as.integer(seq(1, dim(imputed_df)[1], length.out = 5))
imputation_list = list()
levels = c(7,7,7,19,5,4,7,2,17,3,13)
for (i in 1:length(imputation_index)) {
  index = imputation_index[i]
  # need to plus 1 here because the class index of DP function starts at 0
  d = imputed_df[index,] + 1
  dim(d) = dim(t(df_observed))
  d = data.frame(t(d))
  colnames(d) = colnames(df_observed)
  # format columns of d
  for (col_index in 1:ncol(df_observed)) {
    d[,col_index] = factor(d[,col_index], levels = 1:levels[col_index], ordered = TRUE)
  }
  imputation_list[[i]] = d
}

```

Diagnostics

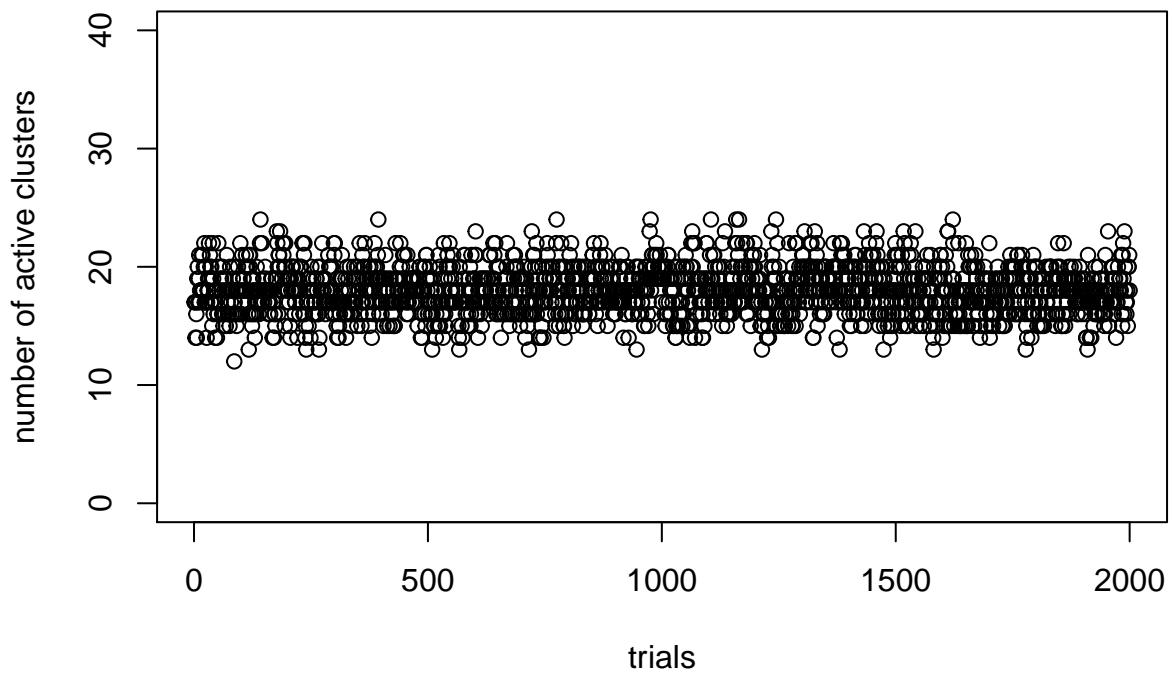
```

source("../utils/create_report.R")
create_report(imputation_list, max_nway=4, missing_col, df_observed)

## ##### Coverage #####
## Coverage 1 way: 90.74 percent
## Coverage 2 way: 93.94 percent
## Coverage 3 way: 97.25 percent
## Coverage 4 way: 98.73 percent
##
## ##### RMSE #####
## RMSE 1 way: 0.005421
## RMSE 2 way: 0.001996
## RMSE 3 way: 0.00068
## RMSE 4 way: 0.000222
##
## ##### MAE #####
## MAE 1 way: 0.003797

```

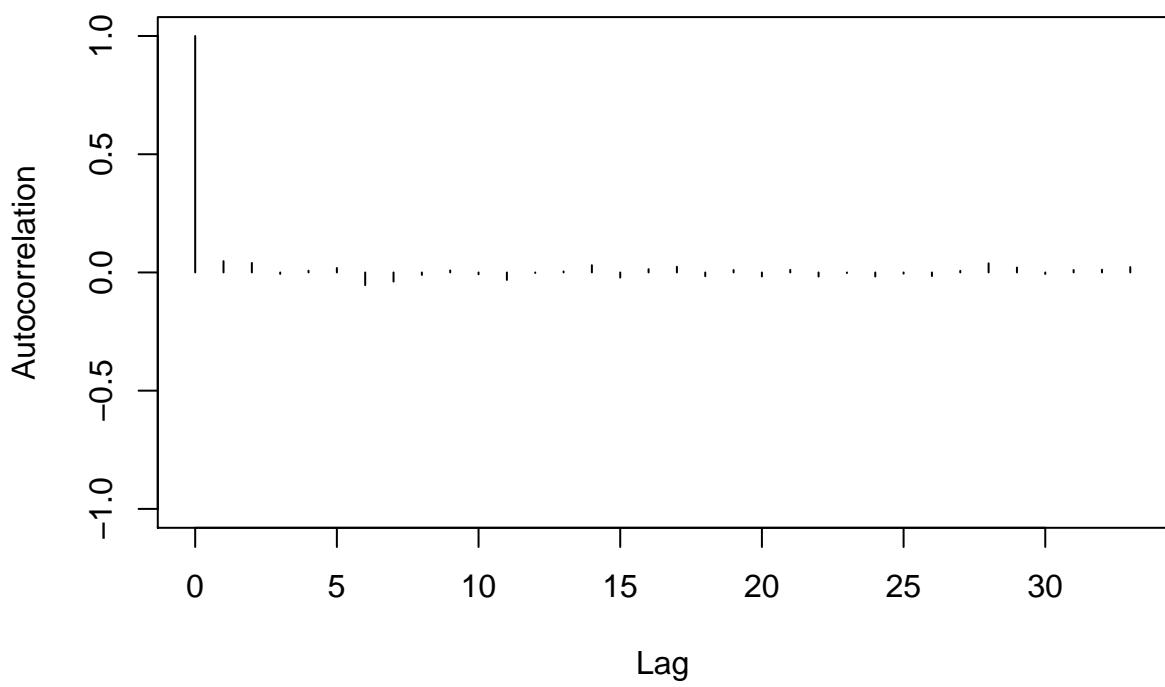
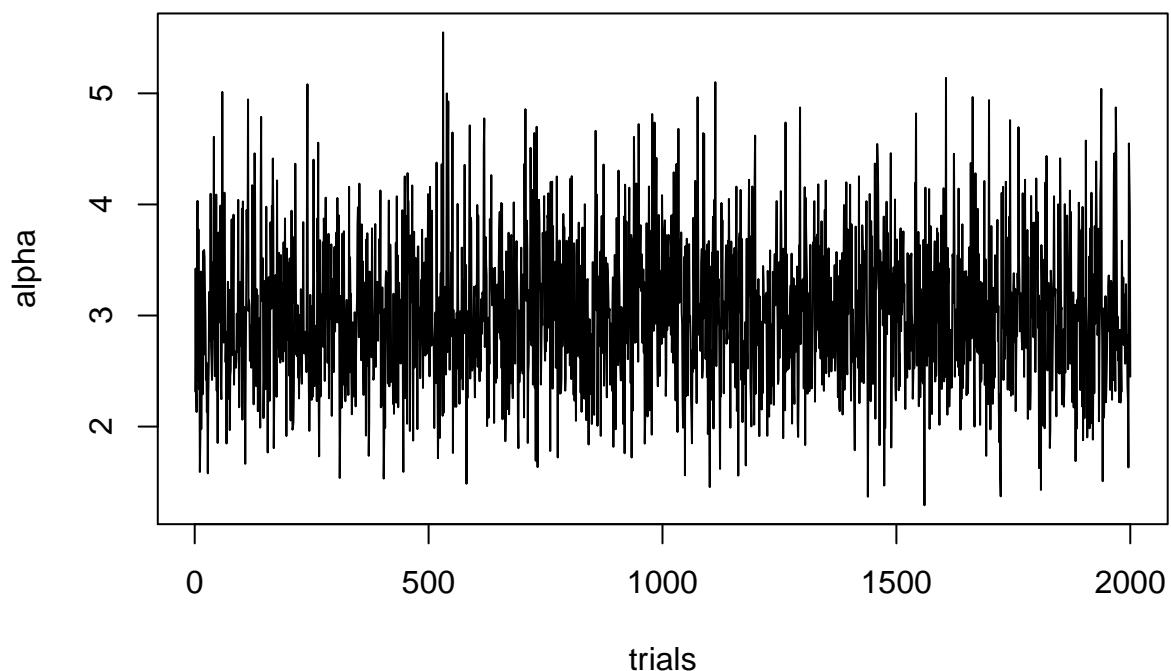
## Number of clusters used over time

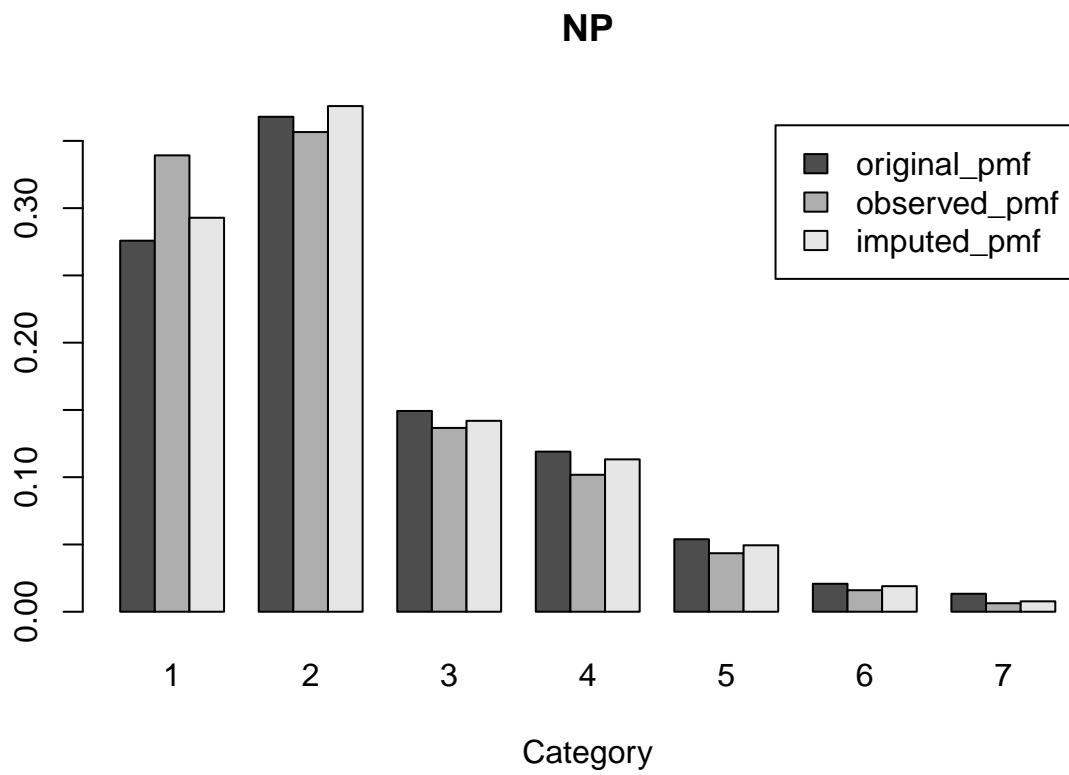
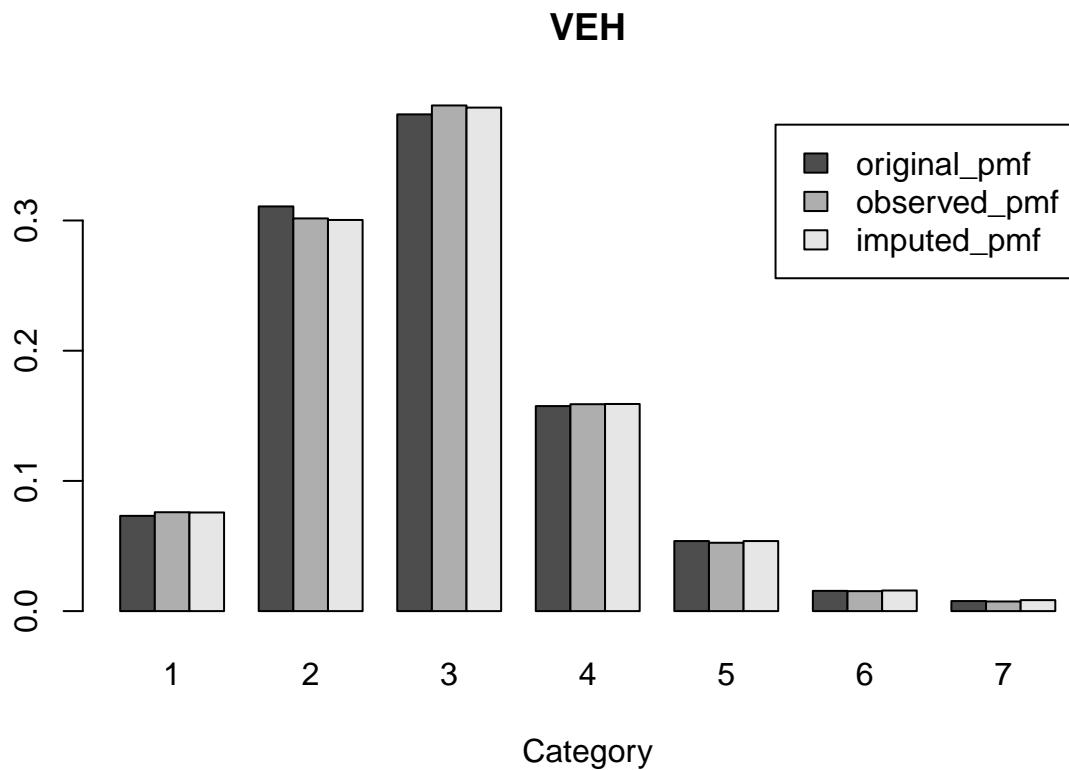


```
## MAE 2 way: 0.000983
## MAE 3 way: 0.000243
## MAE 4 way: 5.8e-05
```

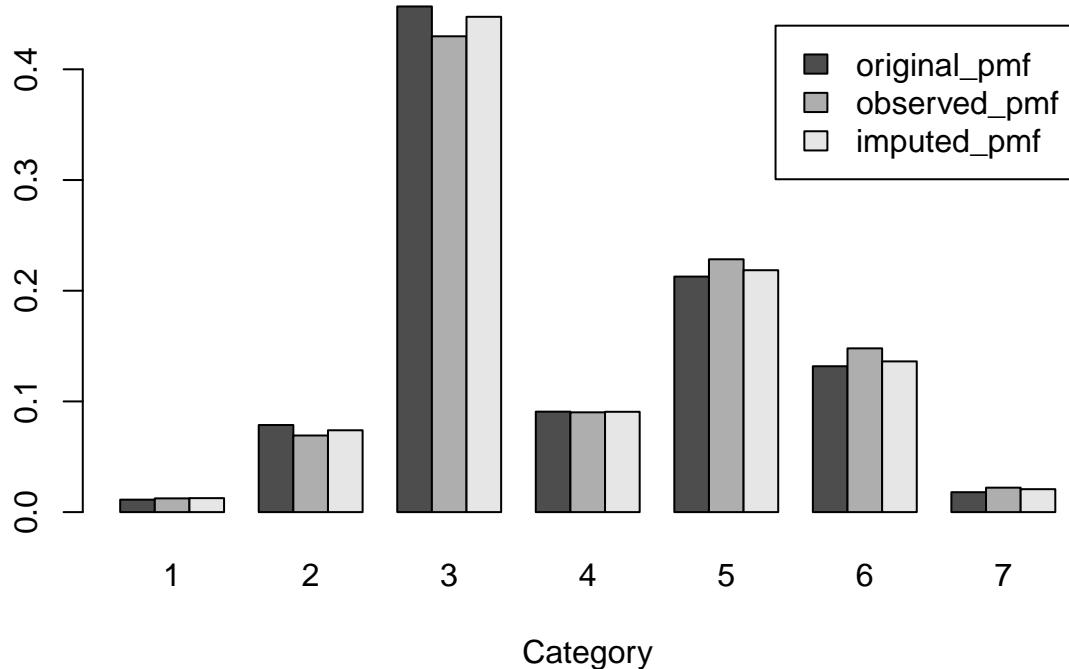
---

### **alpha value for the stick breaking process**

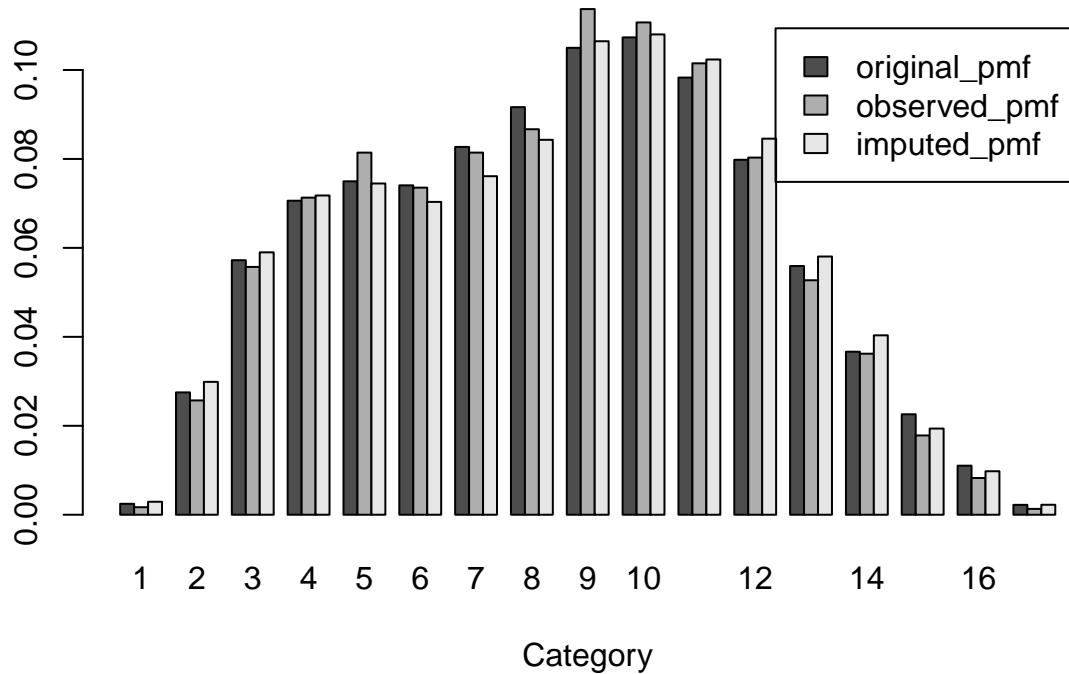




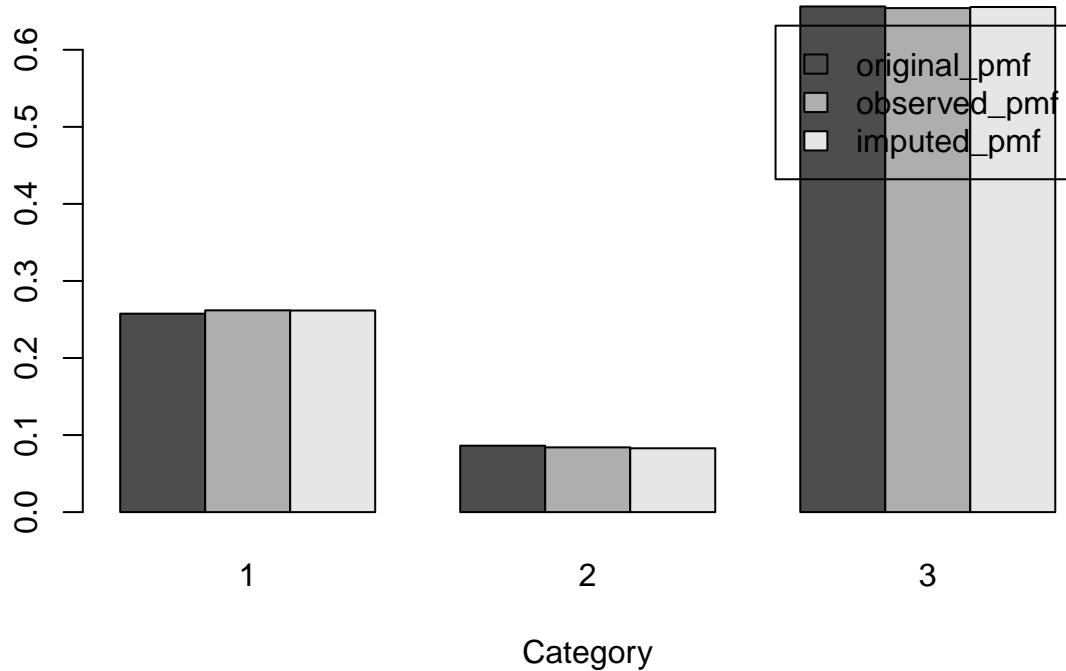
## SCHL



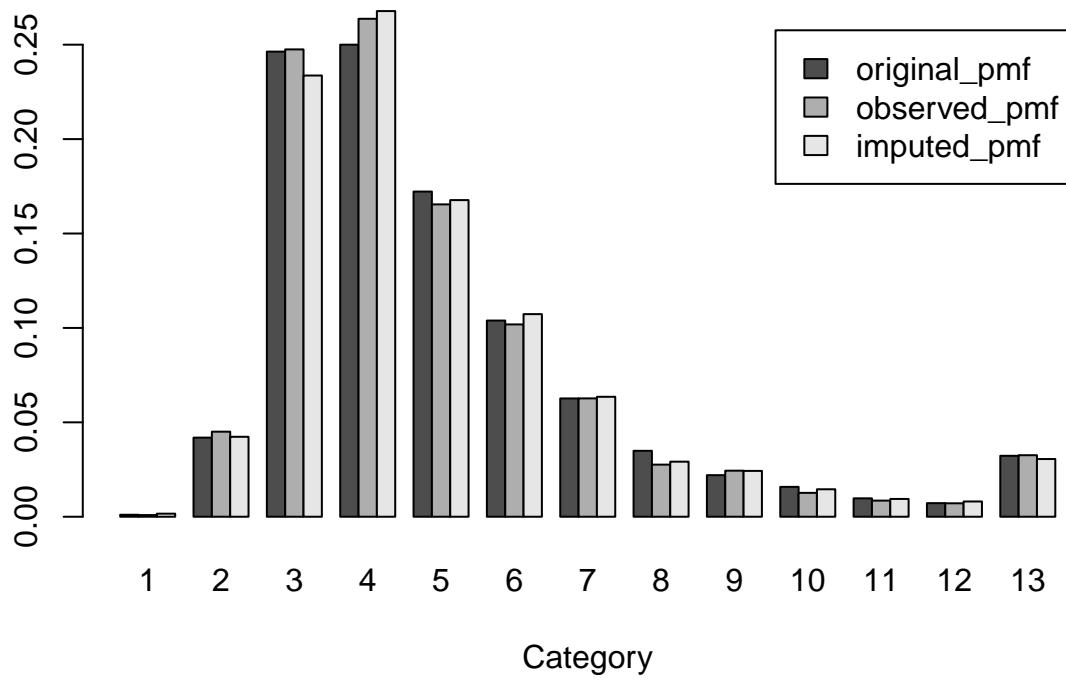
## AGEP



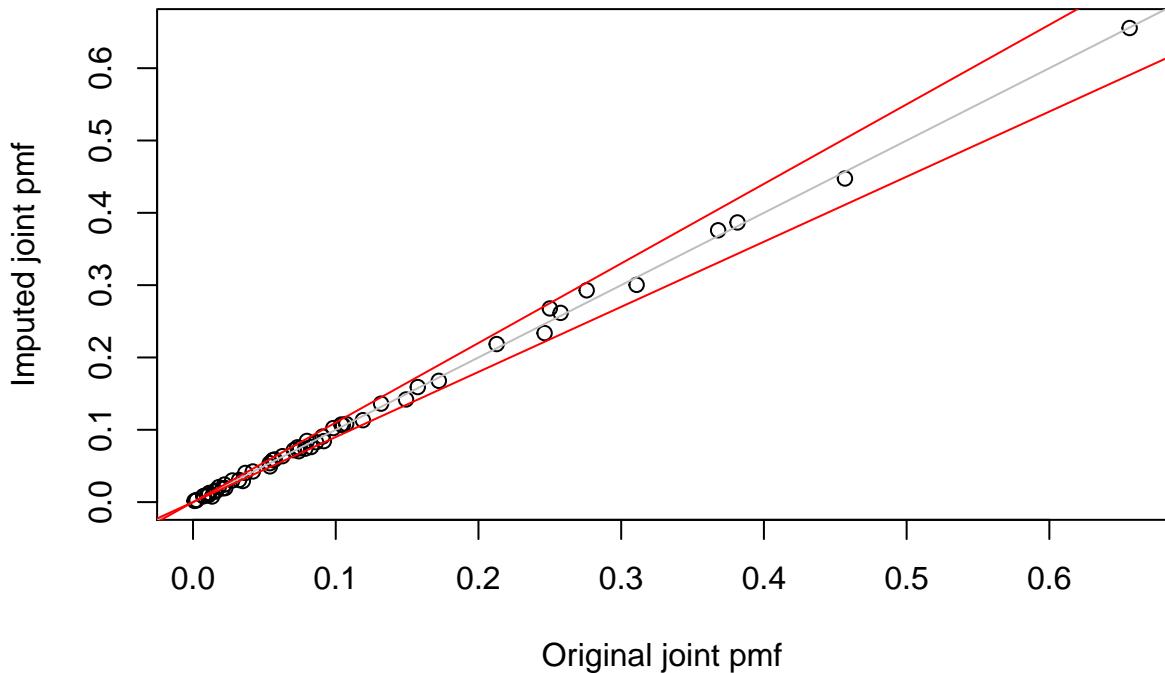
## WKL



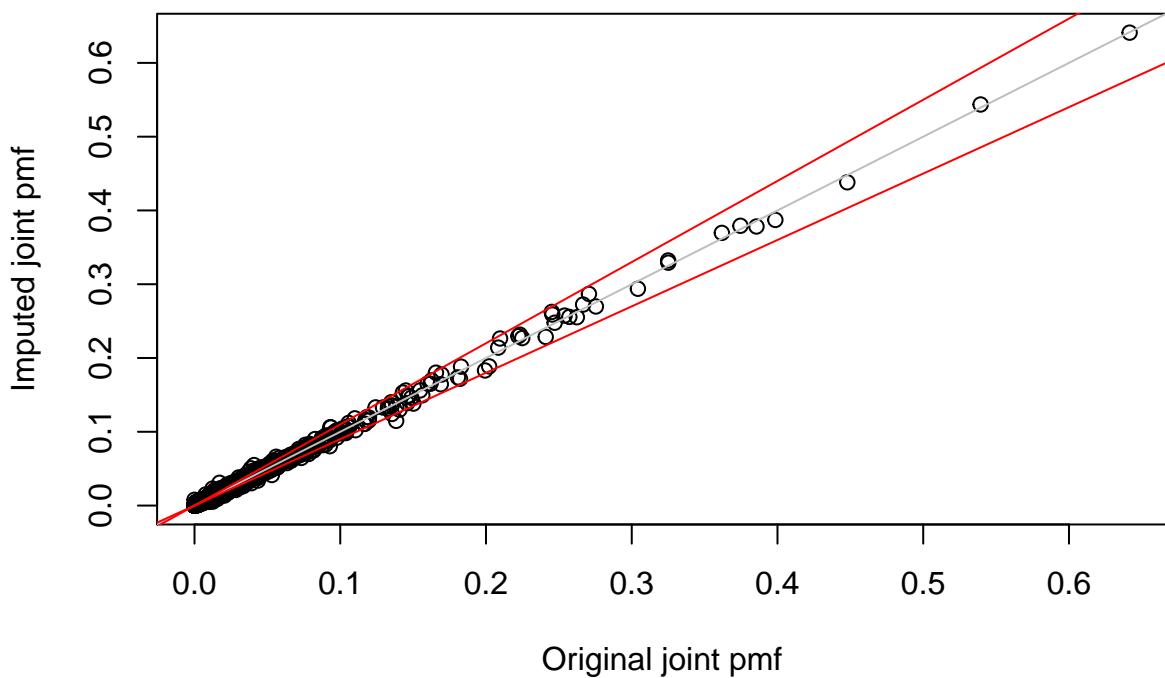
## PINCP



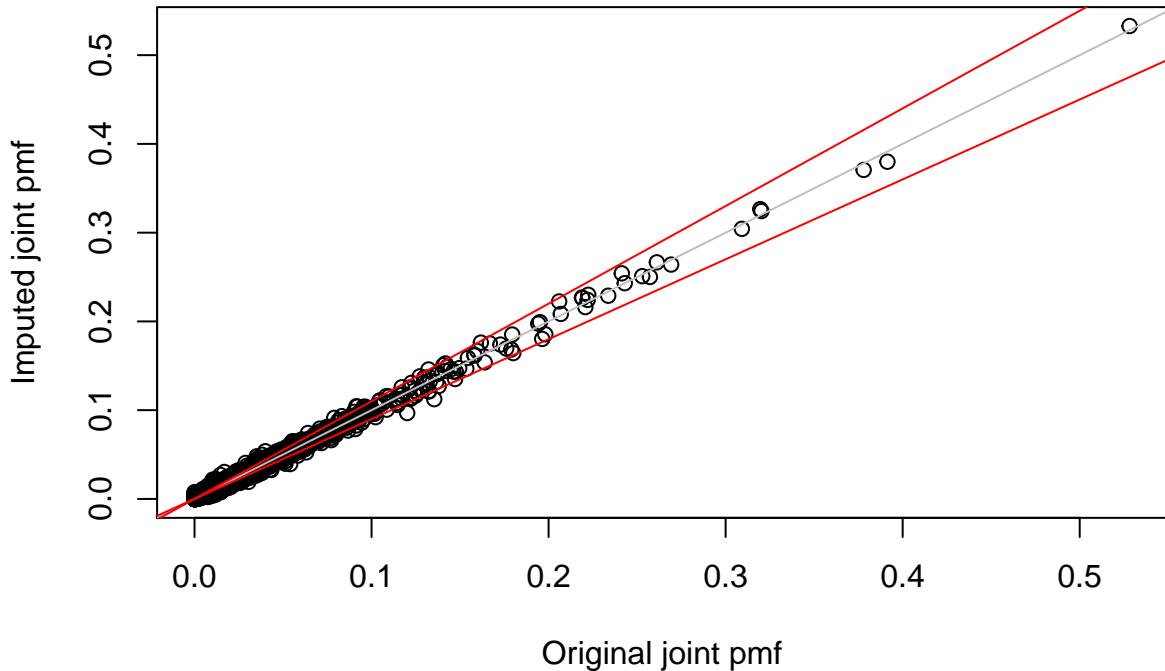
### Assess imputed pmf: 1 way



### Assess imputed pmf: 2 way



**Assess imputed pmf: 3 way**



**Assess imputed pmf: 4 way**

