

# Combining multiple imputations

Thomas Lumley

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Carlin *et al.* (2003) illustrate the use of their Stata texttt for multiple imputations with data from a cohort study of adolescent health. Five sets of imputations were done, separately for male and female participants. The resulting datasets are in `mitools/dta`.

First we read all the datasets into R, using `read.dta` from the `foreign` package.

```
> library(mitools)
> data.dir<-system.file("dta",package="mitools")
> ## read in data
> library(foreign)
> women<-imputationList(lapply(list.files(data.dir,
+                                     pattern="f\\.dta",full=TRUE),
+                               read.dta, warn.missing.labels=FALSE))
> men<-imputationList(lapply(list.files(data.dir,
+                                     pattern="m\\.dta",full=TRUE),
+                               read.dta, warn.missing.labels=FALSE))
```

We now combine the imputations for men and women, first defining a `sex` variable

```
> ## add sex variable
> women<-update(women,sex=0)
> men<-update(men, sex=1)
> ## combine two sets of imputations
> all<-rbind(women,men)
> all
```

```
MI data with 5 datasets
Call: rbind(deparse.level, ...)
```

```
> colnames(all)
```

```
[1] "id"      "wave"    "mmetro"  "parsmk"  "drkfre"  "alcdos"
[7] "alcdhi"  "smk"     "cistot"  "mdrkfre" "sex"
```

Now tabulate drinking frequency by sex

```
> with(all, table(sex, drkfre))
```

```
[[1]]
      drkfre
sex Non drinker not in last wk <3 days last wk >=3 days last wk
  0           282           201           105           12
  1           207           194           134           35
```

```
[[2]]
      drkfre
sex Non drinker not in last wk <3 days last wk >=3 days last wk
  0           282           195           109           14
  1           200           200           132           38
```

```
[[3]]
      drkfre
sex Non drinker not in last wk <3 days last wk >=3 days last wk
  0           278           202           109           11
  1           209           194           131           36
```

```
[[4]]
      drkfre
sex Non drinker not in last wk <3 days last wk >=3 days last wk
  0           284           188           114           14
  1           203           206           128           33
```

```
[[5]]
      drkfre
sex Non drinker not in last wk <3 days last wk >=3 days last wk
```

0	288	191	109	12
1	206	192	136	36

```
attr(",call")
with(all, table(sex, drkfre))
```

and define a new ‘regular drinking’ variables.

```
> all<-update(all, drkreg=as.numeric(drkfre)>2)
> ## tables
> with(all, table(sex, drkreg))
```

```
[[1]]
      drkreg
sex FALSE TRUE
  0    483  117
  1    401  169
```

```
[[2]]
      drkreg
sex FALSE TRUE
  0    477  123
  1    400  170
```

```
[[3]]
      drkreg
sex FALSE TRUE
  0    480  120
  1    403  167
```

```
[[4]]
      drkreg
sex FALSE TRUE
  0    472  128
  1    409  161
```

```
[[5]]
      drkreg
sex FALSE TRUE
```

```
0  479  121
1  398  172
```

```
attr("call")
with(all, table(sex, drkreg))
```

We can now fit a logistic regression model for trends over time in drinking:

```
> ## logistic regression model
> model1<-with(all, glm(drkreg~wave*sex, family=binomial()))
> MIcombine(model1)
```

Multiple imputation results:

```
with(all, glm(drkreg ~ wave * sex, family = binomial()))
MIcombine.default(model1)
      results      se
(Intercept) -2.25974358 0.26830731
wave         0.24055250 0.06587423
sex          0.64905222 0.34919264
wave:sex     -0.03725422 0.08609199
```

```
> summary(MIcombine(model1))
```

Multiple imputation results:

```
with(all, glm(drkreg ~ wave * sex, family = binomial()))
MIcombine.default(model1)
      results      se      (lower      upper) missInfo
(Intercept) -2.25974358 0.26830731 -2.78584855 -1.7336386      4 %
wave         0.24055250 0.06587423  0.11092461  0.3701804     12 %
sex          0.64905222 0.34919264 -0.03537187  1.3334763      1 %
wave:sex     -0.03725422 0.08609199 -0.20623121  0.1317228      7 %
```

For model objects with `coef` and `vcov` methods the extraction of coefficients and variances is automatic, but `MIextract` can still be used:

```
> beta<-MIextract(model1, fun=coef)
> vars<-MIextract(model1, fun=vcov)
> summary(MIcombine(beta,vars))
```

Multiple imputation results:

```
      MIcombine.default(beta, vars)
               results          se      (lower      upper) missInfo
(Intercept) -2.25974358 0.26830731 -2.78584855 -1.7336386      4 %
wave         0.24055250 0.06587423  0.11092461  0.3701804     12 %
sex          0.64905222 0.34919264 -0.03537187  1.3334763      1 %
wave:sex     -0.03725422 0.08609199 -0.20623121  0.1317228      7 %
```

## References

Carlin JB, Li N, Greenwood P, Coffey C. (2003) Tools for analyzing multiply imputed datasets. *Stata Journal* 3:1–20.