

# Combining multiple imputations

Thomas Lumley

October 6, 2005

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")
> 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

```
> women <- update(women, sex = 0)
> men <- update(men, sex = 1)
> 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.imputationList(all, table(sex, drkfre))
```

and define a new ‘regular drinking’ variables.

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

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

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

Multiple imputation results:

```
with.imputationList(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.imputationList(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.