PSY 653 Module 1: Missing Data

Jan 29, 2020

Neil Yetz & Gemma Wallace

Part 1: In class Demo

Load Libraries

```
library(tidyverse)

## Warning: package 'ggplot2' was built under R version 3.6.3

## Warning: package 'tibble' was built under R version 3.6.3

## Warning: package 'tidyr' was built under R version 3.6.3

## Warning: package 'dplyr' was built under R version 3.6.3

## Warning: package 'forcats' was built under R version 3.6.3

library(mice)

## Warning: package 'mice' was built under R version 3.6.3

library(olsrr)

## Warning: package 'olsrr' was built under R version 3.6.3

Read in data
```

```
mice_data1 <- read_csv("mice_data1.csv")
```

Simple Linear regression model $X1 \sim X2$

Using pairwise deletion for missing data by default

```
mod1 <- lm(X1 ~ X2, data = mice_data1)
ols_regress(mod1)</pre>
```

```
Model Summary
## -----
                                    RMSE
## R
                         0.026
                                                       0.714
## R-Squared
                         0.001
                                    Coef. Var
                                                      39.353
## Adj. R-Squared
                        -0.002
                                    MSE
                                                       0.510
## Pred R-Squared
                         -0.009
                                    MAE
                                                       0.592
## RMSE: Root Mean Square Error
## MSE: Mean Square Error
```

MAE: Mean Absolute Error

##

```
ANOVA
## -----
           Sum of
##
##
          Squares
                    DF Mean Square
                                    F
                                          Sig.
## -----
## Regression 0.137 1
## Residual 204.939 402
                           0.137 0.27 0.6039
## Residual 204.939
                             0.510
                 403
## Total
           205.077
##
                        Parameter Estimates
     model Beta Std. Error Std. Beta t Sig lower upper
## -----
## (Intercept) 1.828

      1.828
      0.044
      41.152
      0.000

      -0.011
      0.022
      -0.026
      -0.519
      0.604

                                    41.152 0.000 1.741 1.916
  ___X2
##
                                                  -0.055 0.032
```

Impute the dataset 5 times (using mice)

```
imputed_data <- mice(mice_data1, m=5, maxit = 50, method = 'pmm', seed = 500)</pre>
```

```
##
##
   iter imp variable
      1 X1
    1 2 X1
##
    1 3 X1
##
    1 4 X1
##
##
    1 5 X1
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    2
      1 X1
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             X1
     49
          5
##
     50
          1 X1
```

```
## 50 2 X1
## 50 3 X1
## 50 4 X1
## 50 5 X1
```

Regress X1 on X2 on imputed dataset using the "with" function

```
fit.mi <- with(imputed_data, exp= lm(X1 ~ X2))</pre>
summary(fit.mi)
## # A tibble: 10 x 5
##
      term
                  estimate std.error statistic
                                                 p.value
##
      <chr>
                     <dbl>
                               <dbl>
                                         <dbl>
                                                   <dbl>
##
   1 (Intercept) 1.84
                              0.0425
                                       43.3
                                               3.13e-160
##
   2 X2
                  -0.0106
                              0.0207
                                       -0.513 6.08e- 1
## 3 (Intercept) 1.82
                              0.0423
                                       43.1
                                               9.48e-160
  4 X2
                  -0.00106
                              0.0205
                                       -0.0516 9.59e- 1
## 5 (Intercept) 1.80
                              0.0429
                                       42.0
                                               1.46e-155
##
   6 X2
                  -0.00443
                              0.0208
                                       -0.213 8.32e- 1
##
  7 (Intercept) 1.81
                              0.0419
                                               3.27e-160
                                       43.3
  8 X2
                  -0.00242
                              0.0204
                                       -0.119 9.05e- 1
## 9 (Intercept) 1.84
                              0.0419
                                       43.9
                                               2.47e-162
## 10 X2
                  -0.0119
                              0.0204
                                       -0.584 5.60e- 1
```

Pool model estimates across imputed versions of the dataset

Part 2: Try it yourself

Read in data

```
mice_data2 <- read_csv("mice_data2.csv")
## Warning: Duplicated column names deduplicated: 'X4' => 'X4_1' [5]
```

Multiple Linear regression model $X1 \sim X2 + X3 + X4$

Using pairwise deletion for missing data by default

```
mod2 <- lm(X1 ~ X2 + X3 + X4, data = mice_data2)
ols_regress(mod2)</pre>
```

##	Model Summary		
##			
## R	0.103	RMSE	0.712
## R-Squared	0.011	Coef. Var	39.254
## Adj. R-Squared	0.003	MSE	0.507
## Pred R-Squared	-0.008	MAE	0.588

```
## -----
## RMSE: Root Mean Square Error
## MSE: Mean Square Error
## MAE: Mean Absolute Error
##
                                ANOVA
##
                 Sum of
##
##
                Squares DF Mean Square F Sig.
## -----
## Regression 2.179 3
## Residual 202.898 400
## Total 205.077 403
                                            0.726 1.432 0.2330
                                           0.507
                           403
##
##
                                   Parameter Estimates
## -----
                                                        t Sig
        model
                  Beta Std. Error Std. Beta
                                                                         lower upper
## (Intercept)
                 1.681
                                0.089
                                                      18.832 0.000
                                                                          1.505
                                                                                   1.856
   X2 -0.017
X3 0.079

      X2
      -0.017
      0.022
      -0.040
      -0.789
      0.431
      -0.061
      0.026

      X3
      0.079
      0.040
      0.101
      1.990
      0.047
      0.001
      0.157

      X4
      -0.001
      0.024
      -0.002
      -0.036
      0.971
      -0.048
      0.046

##
##
##
```

Impute the dataset 5 times (using mice)

```
imputed_data <- mice(mice_data2, m=5, maxit = 50, method = 'pmm', seed = 500)</pre>
```

```
##
##
  iter imp variable
##
   1 1 X1
   1 2 X1
##
   1 3 X1
##
##
   1 4 X1
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      5 X1
      1 X1
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     6
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            Х1
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           1
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##
     31
           2
              X1
           3
##
     31
              X1
##
     31
           4
              X1
           5
              X1
##
     31
##
     32
           1
              X1
##
     32
           2
              Х1
##
     32
           3
              X1
##
     32
           4
              X1
##
     32
           5
              X1
##
     33
           1
              X1
           2
##
     33
              Х1
##
     33
           3
              X1
##
     33
           4
              X1
##
     33
              X1
           5
##
     34
           1
              X1
##
     34
           2
              X1
     34
           3
              X1
##
     34
##
           4
              X1
##
     34
           5
              X1
##
     35
              X1
           1
##
     35
           2
              Х1
##
     35
           3
              X1
##
     35
           4
              X1
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     35
           5
              X1
##
     36
           1
              X1
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     36
           2
              X1
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     36
           3
              X1
     36
##
           4
              Х1
##
     36
           5
              X1
##
     37
           1
              X1
##
     37
           2
              X1
##
     37
           3
              X1
##
     37
           4
              X1
##
     37
           5 X1
```

```
##
     38
           1
              X1
##
     38
           2
              X1
     38
              X1
##
           3
##
     38
           4
              X1
##
     38
              X1
           5
##
     39
           1
              X1
           2
              Х1
##
     39
##
     39
           3
              X1
##
     39
           4
              X1
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     39
           5
              X1
##
     40
           1
              X1
##
     40
           2
              X1
##
     40
           3
              X1
##
     40
              Х1
           4
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     40
           5
              X1
              X1
##
     41
           1
##
     41
           2
              X1
##
     41
           3
              Х1
##
     41
           4
              X1
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     41
           5
              X1
##
     42
           1
              X1
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     42
           2
              X1
##
     42
           3
              X1
     42
           4
              X1
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     42
           5
              X1
##
     43
           1
              Х1
##
     43
           2
              X1
##
     43
           3
              X1
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     43
           4
              X1
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     43
           5
              X1
##
     44
              Х1
           1
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     44
           2
              X1
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     44
           3
              X1
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     44
              X1
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##
     44
           5
              X1
##
     45
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              X1
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##
     45
              X1
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     45
           3
              Х1
##
     45
           4
              X1
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     45
           5
              X1
##
     46
              Х1
           1
##
     46
           2
              X1
##
     46
           3
              X1
##
     46
           4
              X1
##
     46
           5
              X1
##
     47
              X1
           1
##
     47
           2
              X1
##
     47
           3
              Х1
##
     47
           4
              X1
##
     47
           5
              X1
##
     48
           1
              X1
           2
##
     48
              X1
##
     48
           3
              X1
##
     48
           4 X1
```

```
##
      48
            5
               X1
##
      49
            1
               X 1
##
      49
            2
               Х1
##
      49
            3
               X1
##
      49
            4
               X1
      49
               X1
##
            5
##
      50
            1
               Х1
##
      50
            2
               Х1
##
      50
            3
               X1
##
               Х1
      50
            4
##
      50
            5
               Х1
```

Regress X1 on X2 on imputed dataset using the "with" function

```
fit.mi2 <- with(imputed_data, exp= lm(X1 ~ X2 + X3 + X4))
summary(fit.mi2)</pre>
```

```
## # A tibble: 20 x 5
##
      term
                    estimate std.error statistic
                                                   p.value
##
      <chr>
                       <dbl>
                                  <dbl>
                                             <dbl>
                                                      <dbl>
   1 (Intercept)
                                 0.0874
                                        19.2
                                                   4.08e-60
                   1.68
   2 X2
                                 0.0211
                                         -1.25
                                                   2.13e- 1
##
                   -0.0263
##
    3 X3
                    0.0871
                                 0.0392
                                          2.22
                                                   2.67e- 2
##
   4 X4
                    0.000103
                                 0.0238
                                          0.00435 9.97e- 1
   5 (Intercept)
                    1.70
                                 0.0862
                                         19.7
                                                   3.09e-62
                   -0.00724
                                 0.0208
                                         -0.348
                                                   7.28e- 1
## 6 X2
##
   7 X3
                    0.0709
                                 0.0386
                                          1.84
                                                   6.71e- 2
##
   8 X4
                   -0.000183
                                 0.0234
                                         -0.00783 9.94e- 1
##
   9 (Intercept)
                   1.68
                                 0.0849
                                         19.8
                                                   1.31e-62
## 10 X2
                   -0.0261
                                 0.0205
                                         -1.28
                                                   2.03e- 1
## 11 X3
                    0.0838
                                 0.0380
                                          2.20
                                                   2.80e- 2
## 12 X4
                    0.000285
                                 0.0231
                                          0.0124
                                                   9.90e- 1
                                 0.0867
## 13 (Intercept)
                    1.69
                                         19.5
                                                   2.79e-61
## 14 X2
                   -0.0268
                                 0.0209
                                         -1.28
                                                   2.00e- 1
## 15 X3
                                 0.0389
                                          2.03
                                                   4.25e- 2
                    0.0791
## 16 X4
                   -0.00353
                                 0.0236
                                         -0.150
                                                   8.81e- 1
## 17 (Intercept)
                                 0.0867
                                         18.9
                    1.64
                                                   1.59e-58
## 18 X2
                    0.00604
                                 0.0209
                                          0.288
                                                   7.73e- 1
                                                   4.14e- 2
## 19 X3
                    0.0795
                                          2.05
                                 0.0389
## 20 X4
                    0.00378
                                 0.0236
                                          0.160
                                                   8.73e- 1
```

Pool model estimates across imputed versions of the dataset

```
combimp2 <- pool(fit.mi2)
summary(combimp2)</pre>
```

```
##
                                                                    p.value
            term
                      estimate std.error
                                             statistic
                                                               df
## 1 (Intercept)
                  1.676699e+00 0.09002441 18.624934170 245.66880 0.0000000
## 2
              X2 -1.610209e-02 0.02649093 -0.607834073 25.07851 0.5487629
## 3
                  8.010165e-02 0.03929906
                                           2.038258926 387.12469 0.0422032
## 4
              Х4
                  9.198331e-05 0.02364814
                                           0.003889664 418.47772 0.9968984
```