Reading and data wrangling in R

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Description

In this file you can find some tips to:

- Reading data from different formats (txt,csv,excel...)
- Cleaning data
- Creation of new variables
- Merging datasets
- Dealing with NA

All of the task above are related with how to clean and tidy our data, that is an inevitable phase when you work with data. Some terms for these activities are: data cleaning, data wrangling and data manipulation.

1. Reading data

There are many ways to import datasets depending on the file characteristics as separator, decimals, head, etc. The easy way is using the botton Import Dataset in the R-Studio enviroment, however you have to copy the code into your script because the lines just run in the console. To know some of the fuctions that appear throw the bottom you are going to find some examples.

- read.csv: comma separated values with period as decimal separator.
- read.csv2: semicolon separated values with comma as decimal separator.
- read.delim: tab-delimited files with period as decimal separator.
- read.delim2 tab-delimited files with comma as decimal separator.
- read.fwf data with a predetermined number of bytes per column.

```
pigeon <-  read.delim("C:/Users/Andrea/Desktop/pigeon-racing.txt")
str(pigeon)
```

```
## 'data.frame':    400 obs. of  11 variables:
##  $ Pos     : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ Breeder : Factor w/ 90 levels "4-Birds","7-11 Syndicate",..: 83 49 47 4 40 24 40 64 9 83 ...
##  $ Pigeon  : Factor w/ 400 levels "0001-AU15-RTEX",..: 272 99 101 283 381 40 383 184 191 271 ...
##  $ Name    : Factor w/ 21 levels "","\"the Duck\"",..: 1 1 18 1 1 1 1 1 1 1 ...
##  $ Color   : Factor w/ 29 levels "BB","BBPD","BBPI",..: 9 26 1 4 6 6 5 6 1 6 ...
##  $ Sex     : Factor w/ 2 levels "C","H": 2 2 2 2 2 2 1 2 2 2 ...
##  $ Ent     : int  1 1 1 1 1 1 2 1 1 2 ...
##  $ Arrival : Factor w/ 355 levels "00:03.0","00:04.0",..: 166 183 184 185 186 188 189 190 191 192 ..
##  $ Speed   : num  172 164 163 163 163 ...
##  $ To.Win  : Factor w/ 365 levels "0:00:00","0:05:21",..: 1 2 3 4 5 6 7 8 9 10 ...
##  $ Eligible: Factor w/ 1 level "Yes": 1 1 1 1 1 1 1 1 1 1 ...
```

excel

The functions explained above don't require intallation of any library because they are in the R core, however to read excel files it is necesary to load the library readxl

```
library(readxl)
spanish_silver <- read_excel("C:/Users/Andrea/Desktop/spanish-silver.xls",
    sheet = "spanish-silver")
```

website

Subsets

Tibble

In all of the examples above the data were loaded as data_frame. However to display a sample of them and their visualization is more easy when the data is convert into a tibble

```
library(tibble)
pigeon_tb <- as_data_frame(pigeon)
pigeon_tb
```

```
## # A tibble: 400 x 11
##      Pos Breeder Pigeon Name  Color Sex     Ent Arrival Speed To.Win
##    <int> <fct>   <fct>  <fct> <fct> <fct> <int> <fct>   <dbl> <fct>
##  1     1 Texas ~ 19633~ ""    BCWF  H         1 42:14.0  172. 0:00:~
##  2     2 Junior~ 0402-~ ""    SIWF  H         1 47:36.0  164. 0:05:~
##  3     3 Jerry ~ 0404-~ Perc~ BB    H         1 47:41.0  163. 0:05:~
##  4     4 Alias-~ 2013-~ ""    BBSP  H         1 47:43.0  163. 0:05:~
##  5     5 Greg G~ 5749-~ ""    BC    H         1 47:44.0  163. 0:05:~
##  6     6 Dal-Te~ 0032-~ ""    BC    H         1 47:51.0  163. 0:05:~
##  7     7 Greg G~ 5768-~ ""    BBWF  C         2 47:53.0  163. 0:05:~
##  8     8 N C Sy~ 1067-~ ""    BC    H         1 47:57.0  163. 0:05:~
##  9     9 Baldwi~ 1194-~ ""    BB    H         1 48:02.0  163. 0:05:~
## 10    10 Texas ~ 19632~ ""    BC    H         2 48:03.0  163. 0:05:~
## # ... with 390 more rows, and 1 more variable: Eligible <fct>
```

This sort of view is obteined directly into the original dataframe with the function head.

```
head(pigeon, n=4)
```

```
##   Pos           Breeder          Pigeon         Name Color Sex Ent Arrival
## 1   1     Texas Outlaws 19633-AU15-FOYS               BCWF   H   1 42:14.0
## 2   2    Junior Juanich   0402-AU15-JRL               SIWF   H   1 47:36.0
## 3   3 Jerry Allensworth  0404-AU15-VITA Perch Potato    BB   H   1 47:41.0
## 4   4       Alias-Alias  2013-AU15-ALIA               BBSP   H   1 47:43.0
##     Speed  To.Win Eligible
## 1 172.155 0:00:00      Yes
## 2 163.569 0:05:21      Yes
## 3 163.442 0:05:27      Yes
## 4 163.392 0:05:28      Yes
```

In this script most of the data will be used in tibbles.

Sampling

After loaded the dataset is useful sampling to know their data and identify steps to clean them.

```
library(dplyr)
pigeon_tb%>%sample_n(4)
```

```
## # A tibble: 4 x 11
##     Pos Breeder Pigeon Name  Color Sex     Ent Arrival Speed To.Win
##   <int> <fct>   <fct>  <fct> <fct> <fct> <int> <fct>   <dbl> <fct>
## 1   360 Goshen~ 5848-~ ""    BB    H         3 12:06.0  91.6 1:29:~
```

```
## 2    35 Clear ~ 0263-~ ""    BB    H         1 49:06.0 161.  0:06:~
## 3   146 Woodse~ 1536-~ ""    RC    H         4 59:00.0 148.  0:16:~
## 4   297 Bynum ~ 27680~ ""    BB    H         4 47:45.0 105.  1:05:~
## # ... with 1 more variable: Eligible <fct>
```

Extracting a percentage in the data set

```
pigeon_tb%>%sample_frac(0.03, replace=FALSE)
```

```
## # A tibble: 12 x 11
##      Pos Breeder Pigeon Name  Color Sex     Ent Arrival Speed To.Win
##    <int> <fct>   <fct>  <fct> <fct> <fct> <int> <fct>   <dbl> <fct>
##  1   255 Debbie~ 0724-~ ""    BB    H         5 34:04.0 114.  0:51:~
##  2    80 Bud & ~ 51102~ ""    BLK   H         2 55:38.0 152.  0:13:~
##  3   360 Goshen~ 5848-~ ""    BB    H         3 12:06.0  91.6 1:29:~
##  4   225 Jb & D  1235-~ ""    BB    H        12 25:08.0 121.  0:42:~
##  5     2 Junior~ 0402-~ ""    SIWF  H         1 47:36.0 164.  0:05:~
##  6    83 Andy S~ 0041-~ ""    BBWF  H         2 55:45.0 152.  0:13:~
##  7   351 Shang ~ 0999-~ ""    BBWF  H         5 01:23.0  97.0 1:19:~
##  8   301 Alias-~ 2017-~ ""    BB    H         8 48:39.0 104.  1:06:~
##  9   274 Equali~ 0940-~ ""    BC    H         4 41:23.0 109.  0:59:~
## 10   226 Andy S~ 0784-~ ""    DCWF  H         7 25:11.0 121.  0:42:~
## 11   397 Twin200 7799-~ ""    SIL   H         2 20:25.0  87.8 1:38:~
## 12   313 Rick B~ 2352-~ ""    BB    H         5 51:10.0 103.  1:08:~
## # ... with 1 more variable: Eligible <fct>
```

Selecting columns

```
pigeon_tb%>%select(Pigeon, Color, Sex)
```

```
## # A tibble: 400 x 3
##    Pigeon          Color Sex
##    <fct>           <fct> <fct>
##  1 19633-AU15-FOYS BCWF  H
##  2 0402-AU15-JRL   SIWF  H
##  3 0404-AU15-VITA  BB    H
##  4 2013-AU15-ALIA  BBSP  H
##  5 5749-AU15-SLI   BC    H
##  6 0032-AU15-DRPC  BC    H
##  7 5768-AU15-SLI   BBWF  C
##  8 1067-AU15-TXHC  BC    H
##  9 1194-AU15-TENT  BB    H
## 10 19632-AU15-FOYS BC    H
## # ... with 390 more rows
```

Filters

- And &
- Or |

```
pigeon_tb%>%filter(Color=='BB'  | Sex=='H')
```

```
## # A tibble: 396 x 11
##      Pos Breeder Pigeon Name  Color Sex     Ent Arrival Speed To.Win
##    <int> <fct>   <fct>  <fct> <fct> <fct> <int> <fct>   <dbl> <fct>
##  1     1 Texas ~ 19633~ ""    BCWF  H         1 42:14.0  172. 0:00:~
##  2     2 Junior~ 0402-~ ""    SIWF  H         1 47:36.0  164. 0:05:~
```

```
##  3     3 Jerry ~ 0404-~ Perc~ BB    H         1 47:41.0  163. 0:05:~
##  4     4 Alias-~ 2013-~ ""    BBSP  H         1 47:43.0  163. 0:05:~
##  5     5 Greg G~ 5749-~ ""    BC    H         1 47:44.0  163. 0:05:~
##  6     6 Dal-Te~ 0032-~ ""    BC    H         1 47:51.0  163. 0:05:~
##  7     8 N C Sy~ 1067-~ ""    BC    H         1 47:57.0  163. 0:05:~
##  8     9 Baldwi~ 1194-~ ""    BB    H         1 48:02.0  163. 0:05:~
##  9    10 Texas ~ 19632~ ""    BC    H         2 48:03.0  163. 0:05:~
## 10    10 Redtex  0024-~ ""    RED   H         1 48:03.0  163. 0:05:~
## # ... with 386 more rows, and 1 more variable: Eligible <fct>
```

```
pigeon_tb%>%filter(Color=='BB'  & Sex=='H')
```

```
## # A tibble: 172 x 11
##      Pos Breeder Pigeon Name  Color Sex     Ent Arrival Speed To.Win
##    <int> <fct>   <fct>  <fct> <fct> <fct> <int> <fct>   <dbl> <fct>
##  1     3 Jerry ~ 0404-~ Perc~ BB    H         1 47:41.0  163. 0:05:~
##  2     9 Baldwi~ 1194-~ ""    BB    H         1 48:02.0  163. 0:05:~
##  3    14 Goshen~ 5834-~ ""    BB    H         1 48:12.0  163. 0:05:~
##  4    16 Flyhom~ 1531-~ ""    BB    H         1 48:15.0  163. 0:06:~
##  5    24 Jb & D  1214-~ ""    BB    H         1 48:36.0  162. 0:06:~
##  6    30 Churn ~ 9216-~ ""    BB    H         1 48:48.0  162. 0:06:~
##  7    32 Alias-~ 2049-~ ""    BB    H         3 48:56.0  162. 0:06:~
##  8    35 Clear ~ 0263-~ ""    BB    H         1 49:06.0  161. 0:06:~
##  9    38 Clear ~ 0235-~ ""    BB    H         2 49:17.0  161. 0:07:~
## 10    40 Skip's~ 5302-~ ""    BB    H         2 49:28.0  161. 0:07:~
## # ... with 162 more rows, and 1 more variable: Eligible <fct>
```

Order by

The "-" makes the order from the grearest to the shortest.

```
pigeon_tb%>%arrange(-Speed)
```

```
## # A tibble: 400 x 11
##      Pos Breeder Pigeon Name  Color Sex     Ent Arrival Speed To.Win
##    <int> <fct>   <fct>  <fct> <fct> <fct> <int> <fct>   <dbl> <fct>
##  1     1 Texas ~ 19633~ ""    BCWF  H         1 42:14.0  172. 0:00:~
##  2     2 Junior~ 0402-~ ""    SIWF  H         1 47:36.0  164. 0:05:~
##  3     3 Jerry ~ 0404-~ Perc~ BB    H         1 47:41.0  163. 0:05:~
##  4     4 Alias-~ 2013-~ ""    BBSP  H         1 47:43.0  163. 0:05:~
##  5     5 Greg G~ 5749-~ ""    BC    H         1 47:44.0  163. 0:05:~
##  6     6 Dal-Te~ 0032-~ ""    BC    H         1 47:51.0  163. 0:05:~
##  7     7 Greg G~ 5768-~ ""    BBWF  C         2 47:53.0  163. 0:05:~
##  8     8 N C Sy~ 1067-~ ""    BC    H         1 47:57.0  163. 0:05:~
##  9     9 Baldwi~ 1194-~ ""    BB    H         1 48:02.0  163. 0:05:~
## 10    10 Texas ~ 19632~ ""    BC    H         2 48:03.0  163. 0:05:~
## # ... with 390 more rows, and 1 more variable: Eligible <fct>
```

2.Cleaning data

Creation of new variables

Split

Split a string by an specific separator

```
library(dplyr)
library(tidyr)
```

```
## Warning: package 'tidyr' was built under R version 3.5.3
```

```
pigeon_tb%>%separate(Pigeon, sep='-', c('Num', 'id', 'det'))
```

```
## # A tibble: 400 x 13
##      Pos Breeder Num   id    det   Name  Color Sex     Ent Arrival Speed
##    <int> <fct>   <chr> <chr> <chr> <fct> <fct> <fct> <int> <fct>   <dbl>
##  1     1 Texas ~ 19633 AU15  FOYS  ""    BCWF  H         1 42:14.0  172.
##  2     2 Junior~ 0402  AU15  JRL   ""    SIWF  H         1 47:36.0  164.
##  3     3 Jerry ~ 0404  AU15  VITA  Perc~ BB    H         1 47:41.0  163.
##  4     4 Alias-~ 2013  AU15  ALIA  ""    BBSP  H         1 47:43.0  163.
##  5     5 Greg G~ 5749  AU15  SLI   ""    BC    H         1 47:44.0  163.
##  6     6 Dal-Te~ 0032  AU15  DRPC  ""    BC    H         1 47:51.0  163.
##  7     7 Greg G~ 5768  AU15  SLI   ""    BBWF  C         2 47:53.0  163.
##  8     8 N C Sy~ 1067  AU15  TXHC  ""    BC    H         1 47:57.0  163.
##  9     9 Baldwi~ 1194  AU15  TENT  ""    BB    H         1 48:02.0  163.
## 10    10 Texas ~ 19632 AU15  FOYS  ""    BC    H         2 48:03.0  163.
## # ... with 390 more rows, and 2 more variables: To.Win <fct>,
## #   Eligible <fct>
```

Concatenate

```
pigeon_tb%>%unite_('new', c('Pos','Sex'), sep = '-')
```

```
## # A tibble: 400 x 10
##    new   Breeder   Pigeon  Name   Color   Ent Arrival Speed To.Win Eligible
##    <chr> <fct>     <fct>   <fct>  <fct> <int> <fct>   <dbl> <fct>  <fct>
##  1 1-H   Texas Ou~ 19633-~ ""     BCWF      1 42:14.0  172. 0:00:~ Yes
##  2 2-H   Junior J~ 0402-A~ ""     SIWF      1 47:36.0  164. 0:05:~ Yes
##  3 3-H   Jerry Al~ 0404-A~ Perch~ BB        1 47:41.0  163. 0:05:~ Yes
##  4 4-H   Alias-Al~ 2013-A~ ""     BBSP      1 47:43.0  163. 0:05:~ Yes
##  5 5-H   Greg Gla~ 5749-A~ ""     BC        1 47:44.0  163. 0:05:~ Yes
##  6 6-H   Dal-Tex ~ 0032-A~ ""     BC        1 47:51.0  163. 0:05:~ Yes
##  7 7-C   Greg Gla~ 5768-A~ ""     BBWF      2 47:53.0  163. 0:05:~ Yes
##  8 8-H   N C Synd~ 1067-A~ ""     BC        1 47:57.0  163. 0:05:~ Yes
##  9 9-H   Baldwin ~ 1194-A~ ""     BB        1 48:02.0  163. 0:05:~ Yes
## 10 10-H  Texas Ou~ 19632-~ ""     BC        2 48:03.0  163. 0:05:~ Yes
## # ... with 390 more rows
```

Variable type conversion

Supose that Ent is a factor variable not a numeric one.

```
pigeon_tb$Ent<- as.factor(pigeon_tb$Ent)
pigeon_tb
```

```
## # A tibble: 400 x 11
##      Pos Breeder Pigeon Name  Color Sex   Ent   Arrival Speed To.Win
##    <int> <fct>   <fct>  <fct> <fct> <fct> <fct> <fct>   <dbl> <fct>
##  1     1 Texas ~ 19633~ ""    BCWF  H     1     42:14.0  172. 0:00:~
##  2     2 Junior~ 0402-~ ""    SIWF  H     1     47:36.0  164. 0:05:~
##  3     3 Jerry ~ 0404-~ Perc~ BB    H     1     47:41.0  163. 0:05:~
##  4     4 Alias-~ 2013-~ ""    BBSP  H     1     47:43.0  163. 0:05:~
```

```
##  5     5 Greg G~ 5749-~ ""    BC    H     1     47:44.0  163. 0:05:~
##  6     6 Dal-Te~ 0032-~ ""    BC    H     1     47:51.0  163. 0:05:~
##  7     7 Greg G~ 5768-~ ""    BBWF  C     2     47:53.0  163. 0:05:~
##  8     8 N C Sy~ 1067-~ ""    BC    H     1     47:57.0  163. 0:05:~
##  9     9 Baldwi~ 1194-~ ""    BB    H     1     48:02.0  163. 0:05:~
## 10    10 Texas ~ 19632~ ""    BC    H     2     48:03.0  163. 0:05:~
## # ... with 390 more rows, and 1 more variable: Eligible <fct>
```

if the variable is as string to convert them type into numeric the function is as.numeric()

4. Merging datasets

It's common that you have to merge many files to obtain your final dataset. In R at the same that Python you need to have the same colname in the key variable.

Joins

R has the SQL functions to join files, the key to join the data sets must have the same name in the files.

```
library(readxl)
athlete_country <- read_excel("C:/Users/Andrea/Desktop/python-ml-course-master/datasets/athletes/athlete
    sheet = "Athelete_Country_Map")

athlete_sport <- read_excel("C:/Users/Andrea/Desktop/python-ml-course-master/datasets/athletes/athlete.
    sheet = "Athelete")

athlete_country
```

```
## # A tibble: 6,970 x 2
##    Athlete          Country
##    <chr>            <chr>
##  1 Michael Phelps   United States
##  2 Natalie Coughlin United States
##  3 Aleksey Nemov    Russia
##  4 Alicia Coutts    Australia
##  5 Missy Franklin   United States
##  6 Ryan Lochte      United States
##  7 Allison Schmitt  United States
##  8 Ian Thorpe       Australia
##  9 Dara Torres      United States
## 10 Cindy Klassen    Canada
## # ... with 6,960 more rows
```

```
athlete_sport
```

```
## # A tibble: 6,975 x 2
##    Athlete          Sport
##    <chr>            <chr>
##  1 Michael Phelps   Swimming
##  2 Natalie Coughlin Swimming
##  3 Aleksey Nemov    Gymnastics
##  4 Alicia Coutts    Swimming
##  5 Missy Franklin   Swimming
##  6 Ryan Lochte      Swimming
##  7 Allison Schmitt  Swimming
##  8 Ian Thorpe       Swimming
```

```
##  9 Dara Torres      Swimming
## 10 Cindy Klassen    Speed Skating
## # ... with 6,965 more rows
```

For this example the key is the column called 'Athlete'

```
inner_join(athlete_country, athlete_sport, by='Athlete')
```

```
## # A tibble: 6,994 x 3
##    Athlete          Country       Sport
##    <chr>            <chr>         <chr>
##  1 Michael Phelps   United States Swimming
##  2 Natalie Coughlin United States Swimming
##  3 Aleksey Nemov    Russia        Gymnastics
##  4 Alicia Coutts    Australia     Swimming
##  5 Missy Franklin   United States Swimming
##  6 Ryan Lochte      United States Swimming
##  7 Allison Schmitt  United States Swimming
##  8 Ian Thorpe       Australia     Swimming
##  9 Dara Torres      United States Swimming
## 10 Cindy Klassen    Canada        Speed Skating
## # ... with 6,984 more rows
```

the structure to reproduce left and right join is the same that the example above.

5. Dealing with NA

Counting the na values

```
sapply(pigeon_tb, function(x) sum(is.na(x)))
```

```
##      Pos  Breeder   Pigeon     Name    Color      Sex      Ent  Arrival
##        0        0        0        0        0        0        0        0
##    Speed   To.Win Eligible
##        0        0        0
```

This is weird especially when I new that in name there are too many rows in blank, then one of the levels of the variable must be ""

```
levels(pigeon_tb$Name)
```

```
##  [1] ""               "\"the Duck\""   "Alice"          "BATTLE BORN 27"
##  [5] "Bella"          "BLACK NIGTH 9"  "Canned Heat"    "Charlie"
##  [9] "Christie"       "Color Me Hot"   "Edward"         "Elle"
## [13] "Gage"           "Gypsy"          "Jack Frost"     "Kingston"
## [17] "Lil Dat"        "Perch Potato"   "Pop's Pick"     "Rogue Brew"
## [21] "SEMPER FI 11"
```

The level "" is defining as NA

```
levels(pigeon_tb$Name)[levels(pigeon_tb$Name)==""]<-NA
levels(pigeon_tb$Name)
```

```
##  [1] "\"the Duck\""   "Alice"          "BATTLE BORN 27" "Bella"
##  [5] "BLACK NIGTH 9"  "Canned Heat"    "Charlie"        "Christie"
##  [9] "Color Me Hot"   "Edward"         "Elle"           "Gage"
## [13] "Gypsy"          "Jack Frost"     "Kingston"       "Lil Dat"
## [17] "Perch Potato"   "Pop's Pick"     "Rogue Brew"     "SEMPER FI 11"
```

```
pigeon_tb
```

```
## # A tibble: 400 x 11
##      Pos Breeder Pigeon Name  Color Sex   Ent   Arrival Speed To.Win
##    <int> <fct>   <fct>  <fct> <fct> <fct> <fct> <fct>   <dbl> <fct>
##  1     1 Texas ~ 19633~ <NA>  BCWF  H     1     42:14.0  172. 0:00:~
##  2     2 Junior~ 0402-~ <NA>  SIWF  H     1     47:36.0  164. 0:05:~
##  3     3 Jerry ~ 0404-~ Perc~ BB    H     1     47:41.0  163. 0:05:~
##  4     4 Alias-~ 2013-~ <NA>  BBSP  H     1     47:43.0  163. 0:05:~
##  5     5 Greg G~ 5749-~ <NA>  BC    H     1     47:44.0  163. 0:05:~
##  6     6 Dal-Te~ 0032-~ <NA>  BC    H     1     47:51.0  163. 0:05:~
##  7     7 Greg G~ 5768-~ <NA>  BBWF  C     2     47:53.0  163. 0:05:~
##  8     8 N C Sy~ 1067-~ <NA>  BC    H     1     47:57.0  163. 0:05:~
##  9     9 Baldwi~ 1194-~ <NA>  BB    H     1     48:02.0  163. 0:05:~
## 10    10 Texas ~ 19632~ <NA>  BC    H     2     48:03.0  163. 0:05:~
## # ... with 390 more rows, and 1 more variable: Eligible <fct>
```

References

Van der Loo, M. and De Jonge, E. (2013) An introduction to data cleaning with R. https://cran.r-project.org/doc/contrib/de_Jonge+van_der_Loo-Introduction_to_data_cleaning_with_R.pdf

Hadley Wickham, Romain François, Lionel Henry and Kirill Müller (2019). dplyr: A Grammar of Data Manipulation. R package version 0.8.3. https://CRAN.R-project.org/package=dplyr

Hadley Wickham and Lionel Henry (2019). tidyr: Easily Tidy Data with 'spread()' and 'gather()' Functions. R package version 0.8.3. https://CRAN.R-project.org/package=tidyr

Kirill Müller and Hadley Wickham (2019). tibble: Simple Data Frames. R package version 2.1.3. https://CRAN.R-project.org/package=tibble

Hadley Wickham and Jennifer Bryan (2019). readxl: Read Excel Files. R package version 1.3.1.

https://CRAN.R-project.org/package=readxl

Hadley Wickham (2017). tidyverse: Easily Install and Load the 'Tidyverse'. R package version 1.2.1. https://CRAN.R-project.org/package=tidyverse

Usefull resources

- Presentation data cleaning Jonge. https://www.r-project.ro/conference2017/presentations/uRos2017_data-cleaning-workshop.pdf