Nordsjællands Hospital
Neurologisk afdeling

Introduktion til R/R-studio

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cand.scient.san, PhD

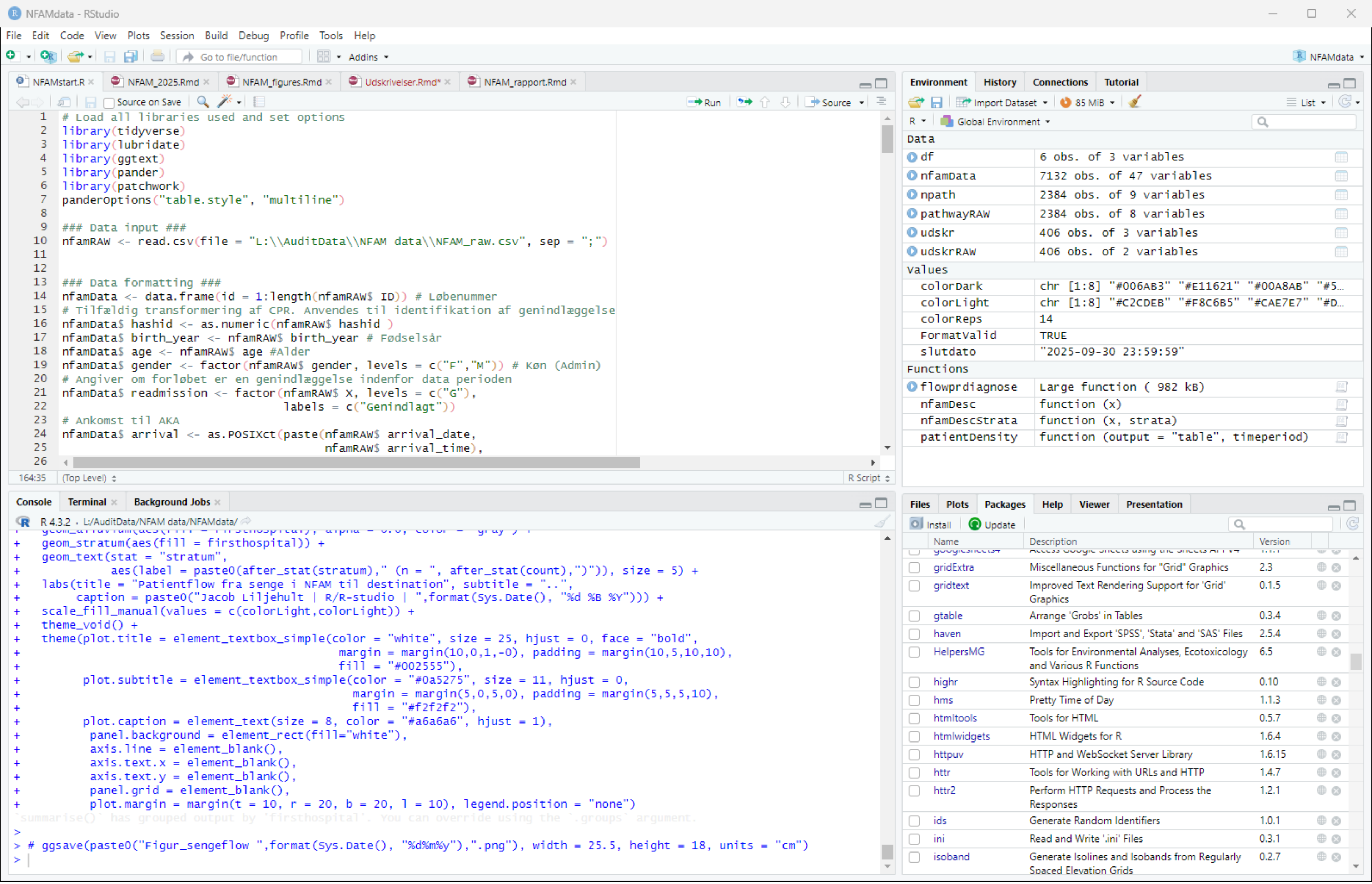
Hvorfor vælge R/RStudio

Fordele

- Open-source og gratis (kræver ikke licens)
- Meget fleksibelt – alle analyser er tilgængelige i et program
- Simplere kodning end i SAS
- Let at få hjælp – mange ressourcer tilgængelige

Ulemper

- Man skal lære at kode
- Kodningen kan være inkonsistent



```r
# Load all libraries used and set options
library(tidyverse)
library(lubridate)
library(ggtext)
library(pander)
library(patchwork)
panderOptions("table.style", "multiline")

### Data input ###
nfamRAW <- read.csv(file = "L:\\AuditData\\NFAM data\\NFAM_raw.csv", sep = ";")


### Data formatting ###
nfamData <- data.frame(id = 1:length(nfamRAW$ ID)) # Løbenummer
# Tilfældig transformering af CPR. Anvendes til identifikation af genindlæggelse
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nfamData$ gender <- factor(nfamRAW$ gender, levels = c("F","M")) # Køn (Admin)
# Angiver om forløbet er en genindlæggelse indenfor data perioden
nfamData$ readmission <- factor(nfamRAW$ X, levels = c("G"),
                                labels = c("Genindlagt"))
# Ankomst til AKA
nfamData$ arrival <- as.POSIXct(paste(nfamRAW$ arrival_date,
                                      nfamRAW$ arrival_time),
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+   geom_stratum(aes(fill = firsthospital)) +
+   geom_text(stat = "stratum",
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+   labs(title = "Patientflow fra senge i NFAM til destination", subtitle = "..",
+        caption = paste0("Jacob Liljehult | R/R-studio | ",format(Sys.Date(), "%d %B %Y"))) +
+   scale_fill_manual(values = c(colorLight,colorLight)) +
+   theme_void() +
+   theme(plot.title = element_textbox_simple(color = "white", size = 25, hjust = 0, face = "bold",
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df	6 obs. of 3 variables
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colorDark	chr [1:8] "#006AB3" "#E11621" "#00A8AB" "#5…
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colorReps	14
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Functions	
flowprdiagnose	Large function (982 kB)
nfamDesc	function (x)
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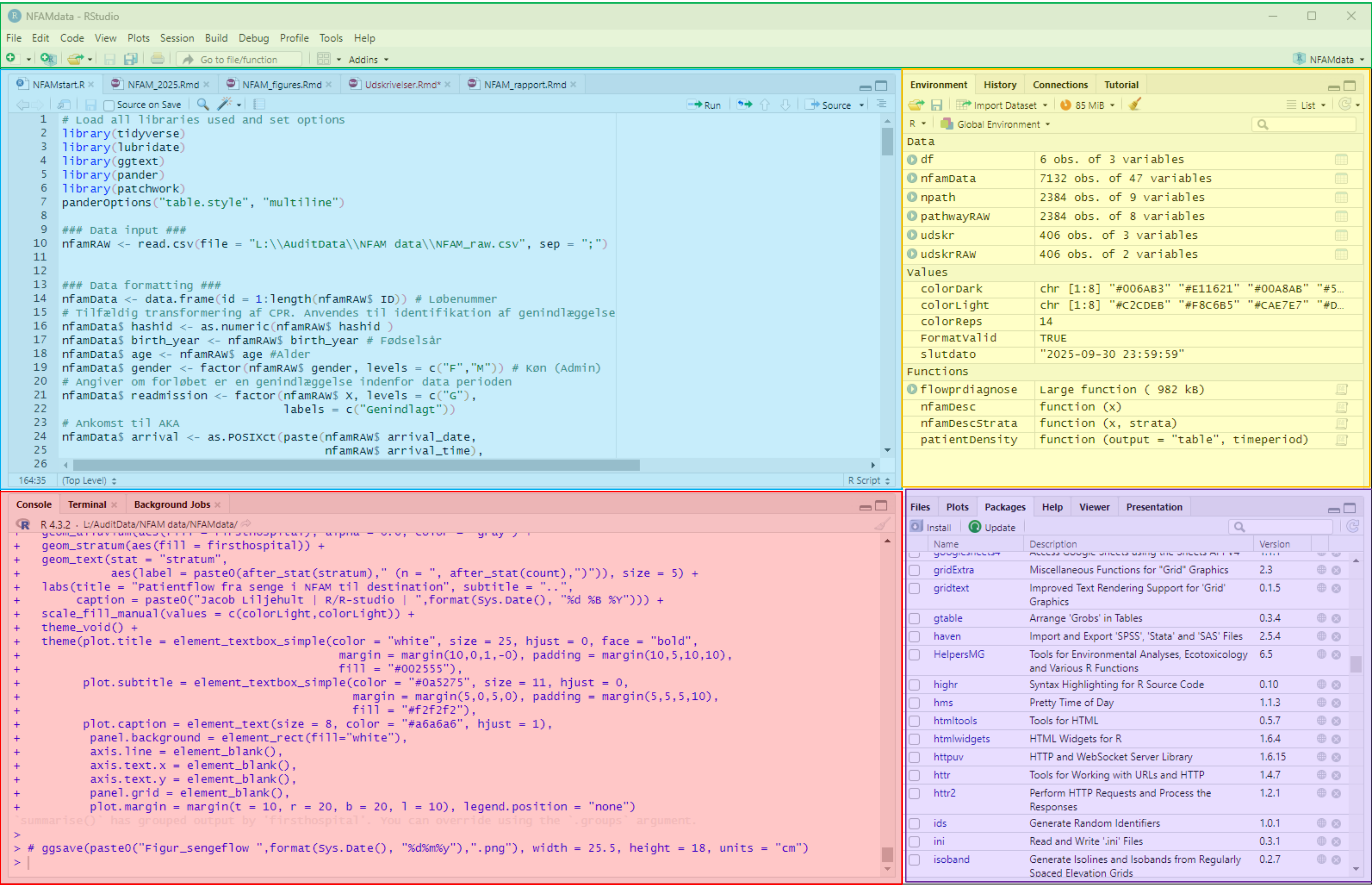

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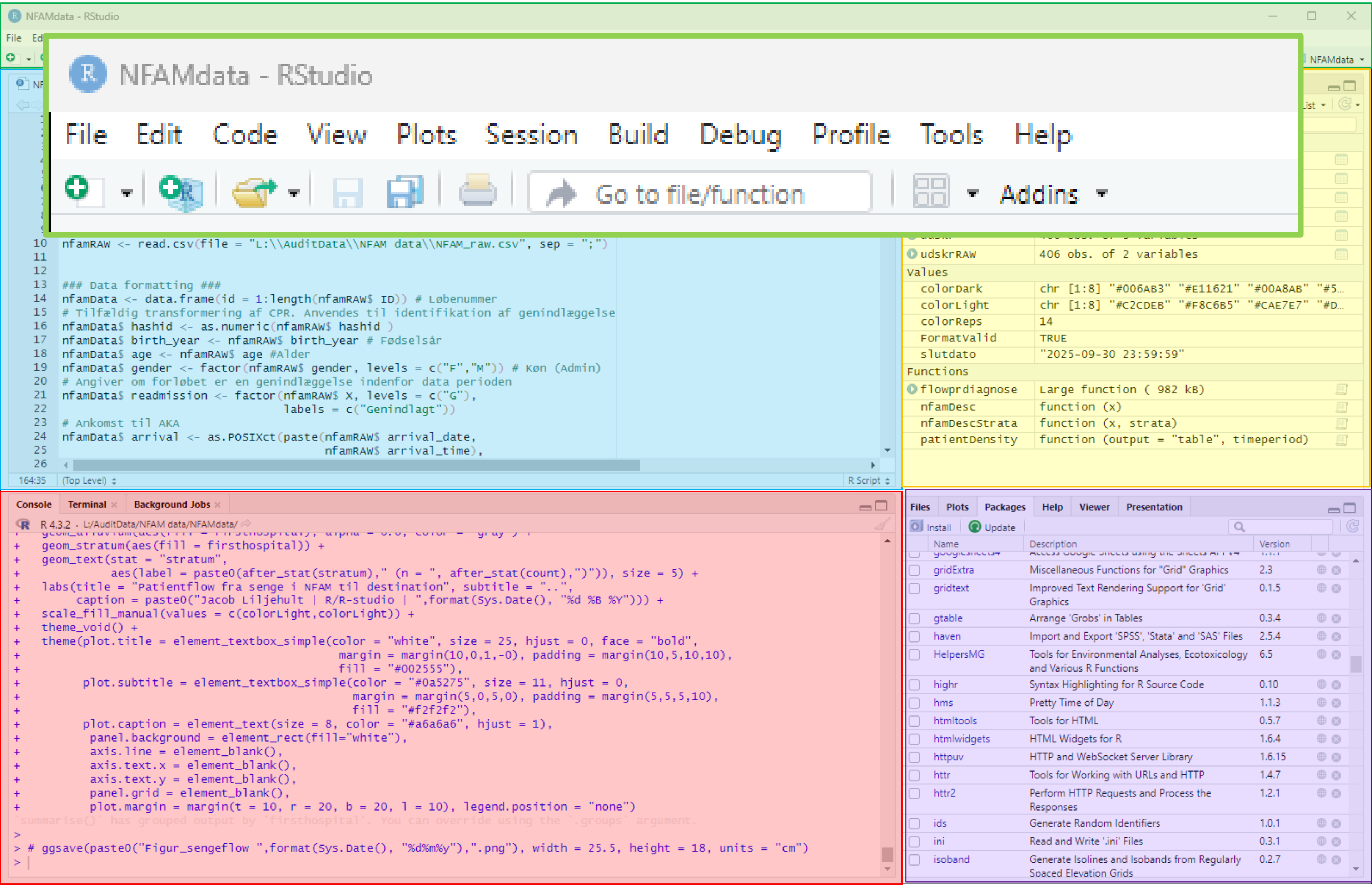

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164:35

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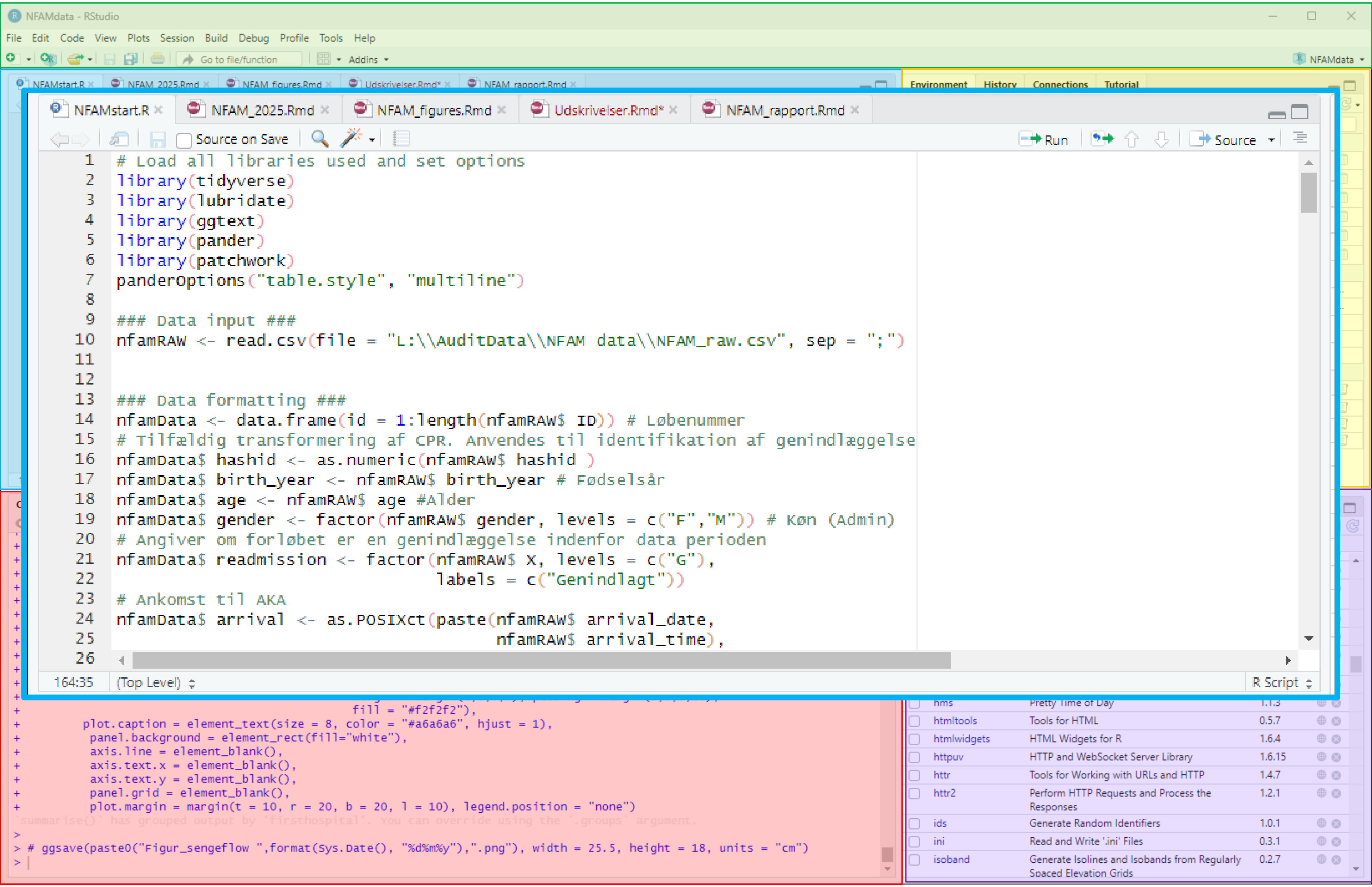

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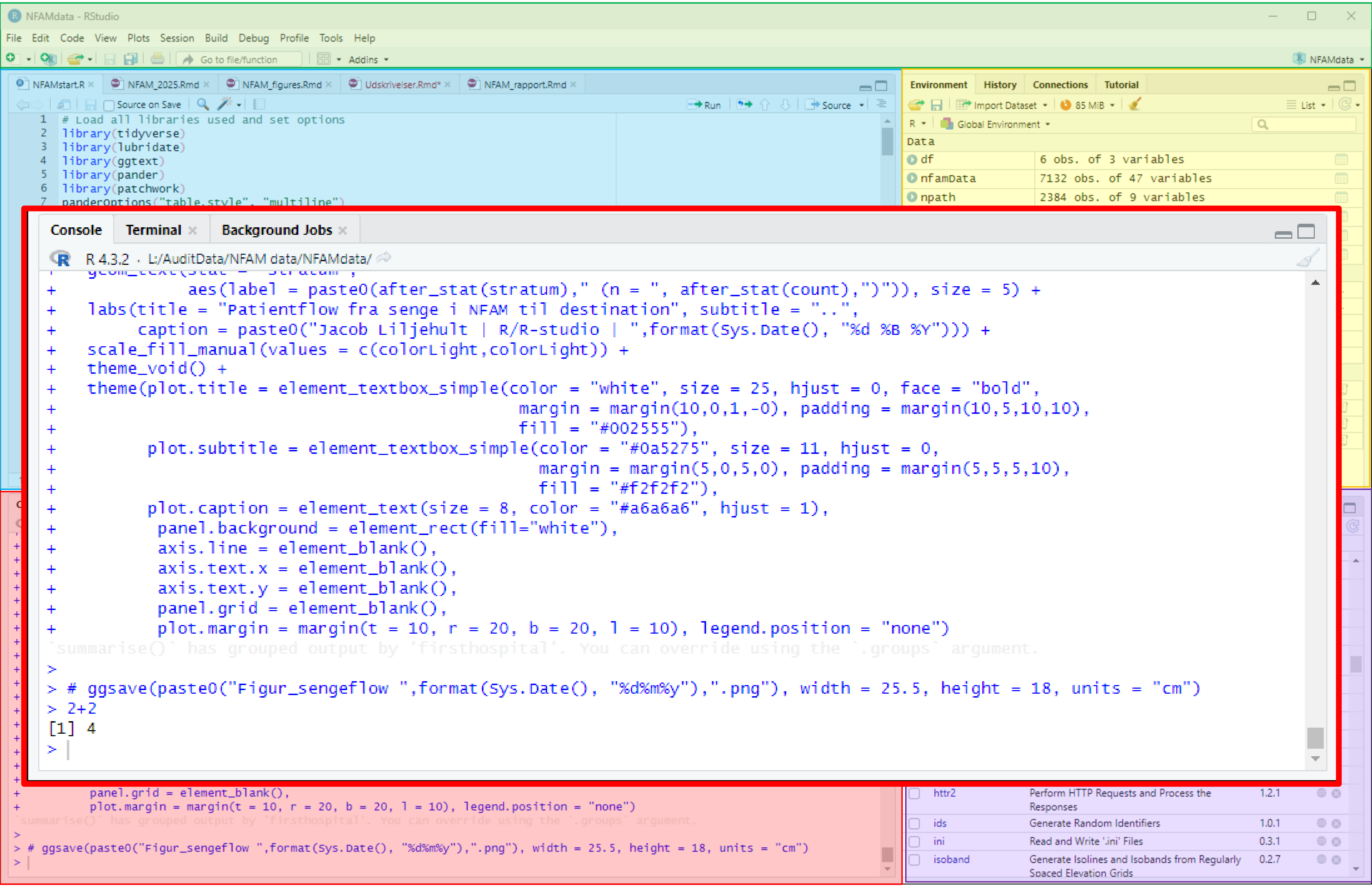

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[1] 4
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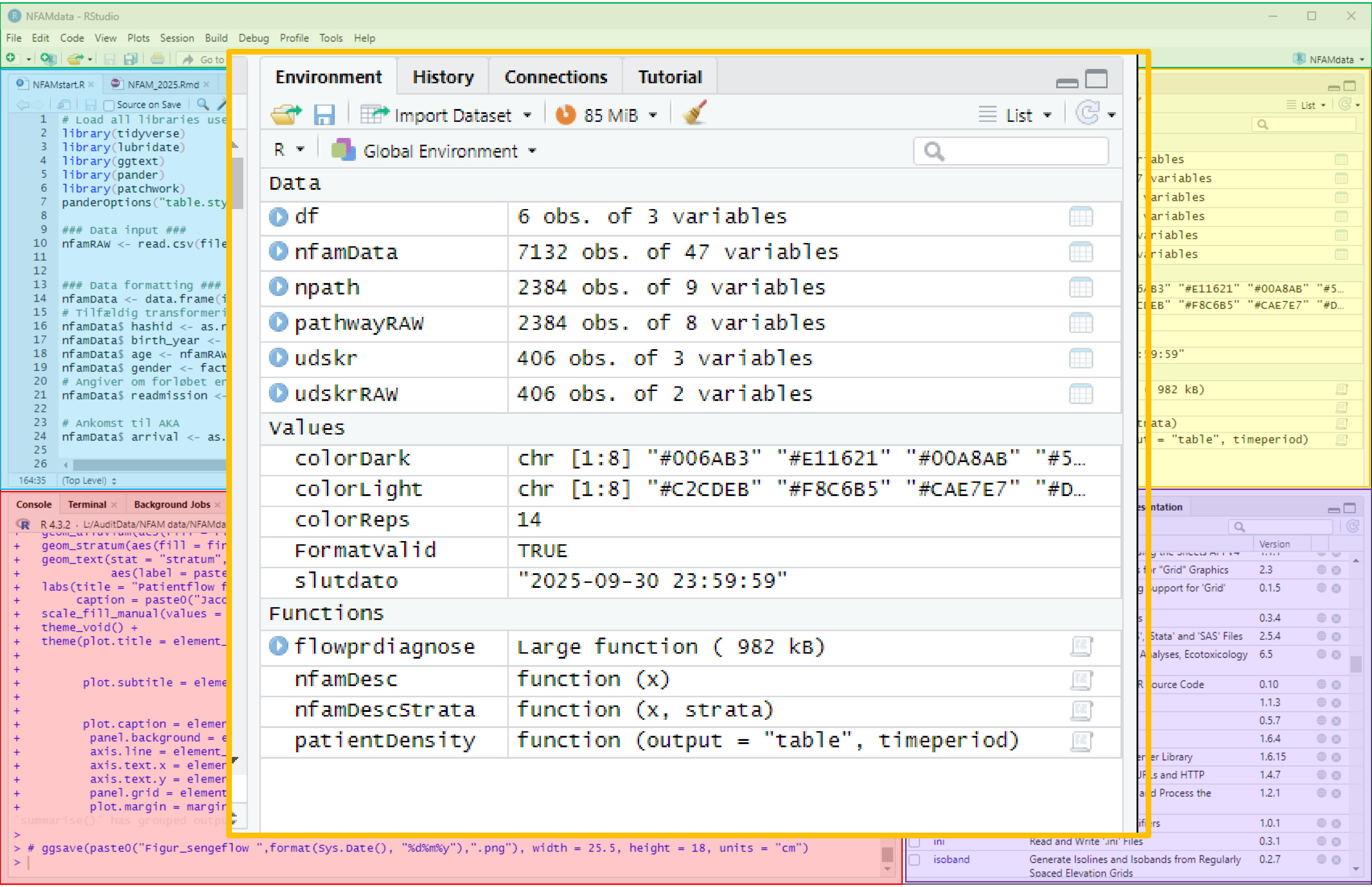

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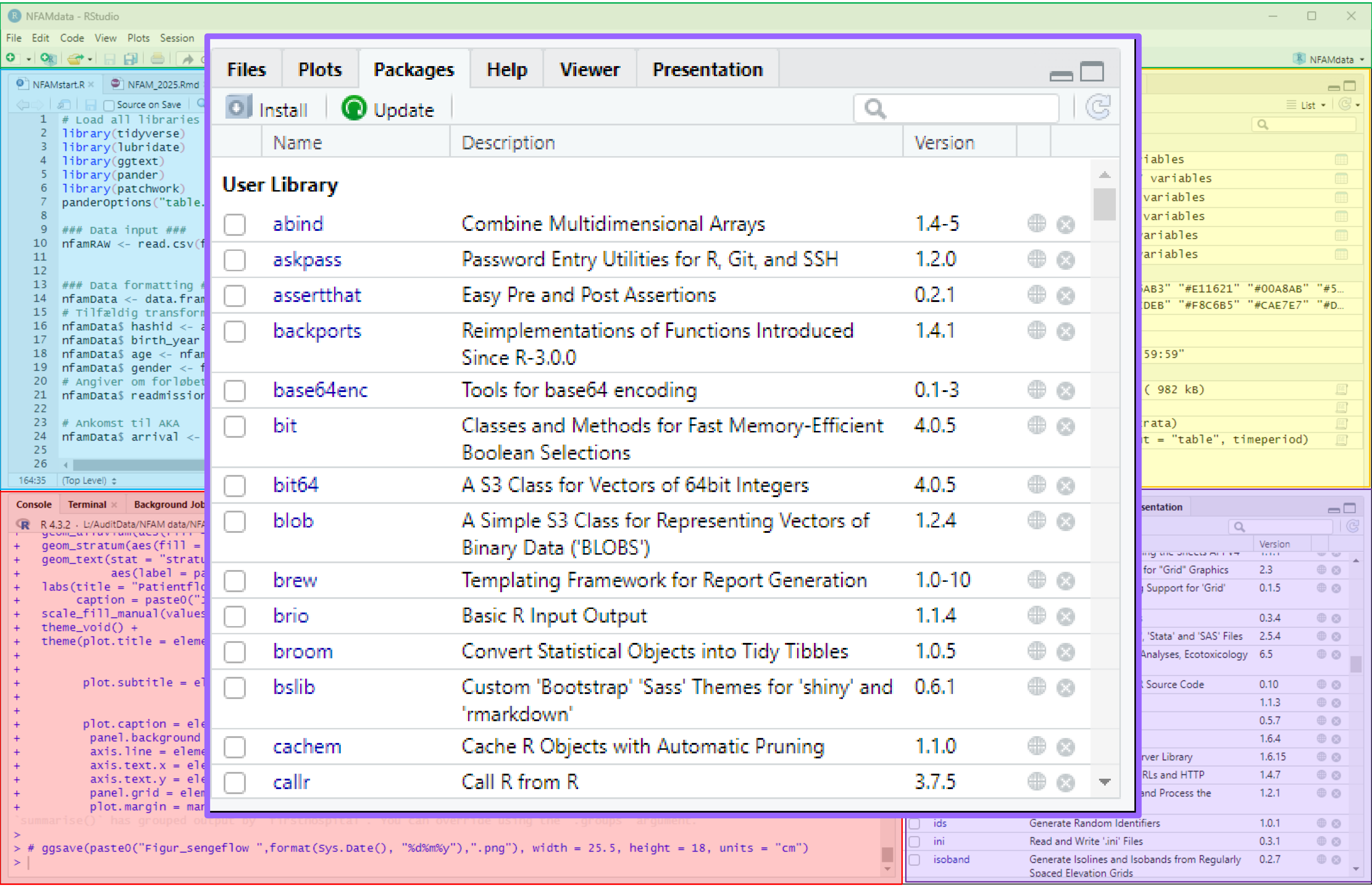

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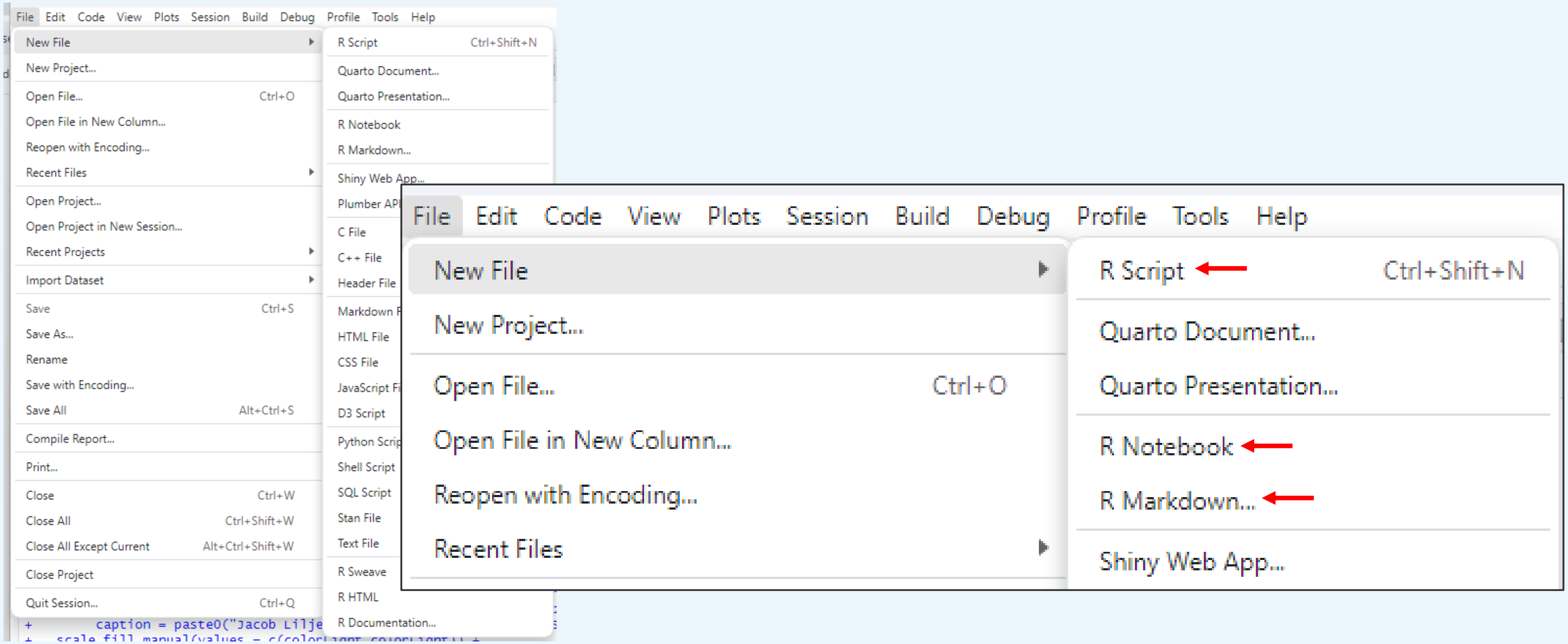
User Library

	Name	Description	Version
☐	abind	Combine Multidimensional Arrays	1.4-5
☐	askpass	Password Entry Utilities for R, Git, and SSH	1.2.0
☐	assertthat	Easy Pre and Post Assertions	0.2.1
☐	backports	Reimplementations of Functions Introduced Since R-3.0.0	1.4.1
☐	base64enc	Tools for base64 encoding	0.1-3
☐	bit	Classes and Methods for Fast Memory-Efficient Boolean Selections	4.0.5
☐	bit64	A S3 Class for Vectors of 64bit Integers	4.0.5
☐	blob	A Simple S3 Class for Representing Vectors of Binary Data ('BLOBS')	1.2.4
☐	brew	Templating Framework for Report Generation	1.0-10
☐	brio	Basic R Input Output	1.1.4
☐	broom	Convert Statistical Objects into Tidy Tibbles	1.0.5
☐	bslib	Custom 'Bootstrap' 'Sass' Themes for 'shiny' and 'rmarkdown'	0.6.1
☐	cachem	Cache R Objects with Automatic Pruning	1.1.0
☐	callr	Call R from R	3.7.5

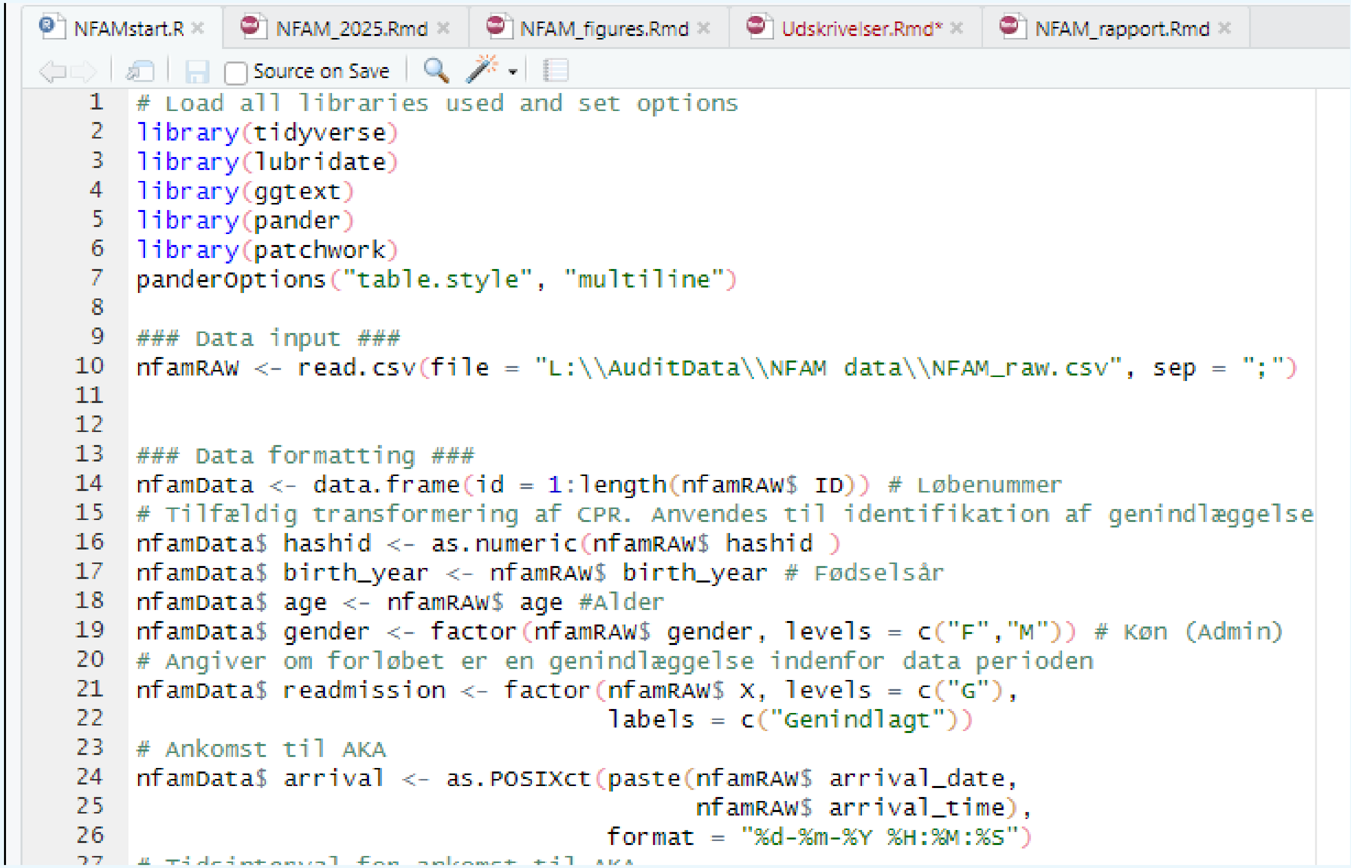
	Name	Description	Version
☐	ids	Generate Random Identifiers	1.0.1
☐	ini	Read and Write '.ini' Files	0.3.1
☐	isoband	Generate Isolines and Isobands from Regularly Spaced Elevation Grids	0.2.7

Projekter og filer



```
+       caption = paste0("Jacob Lilje
```

R-script fil



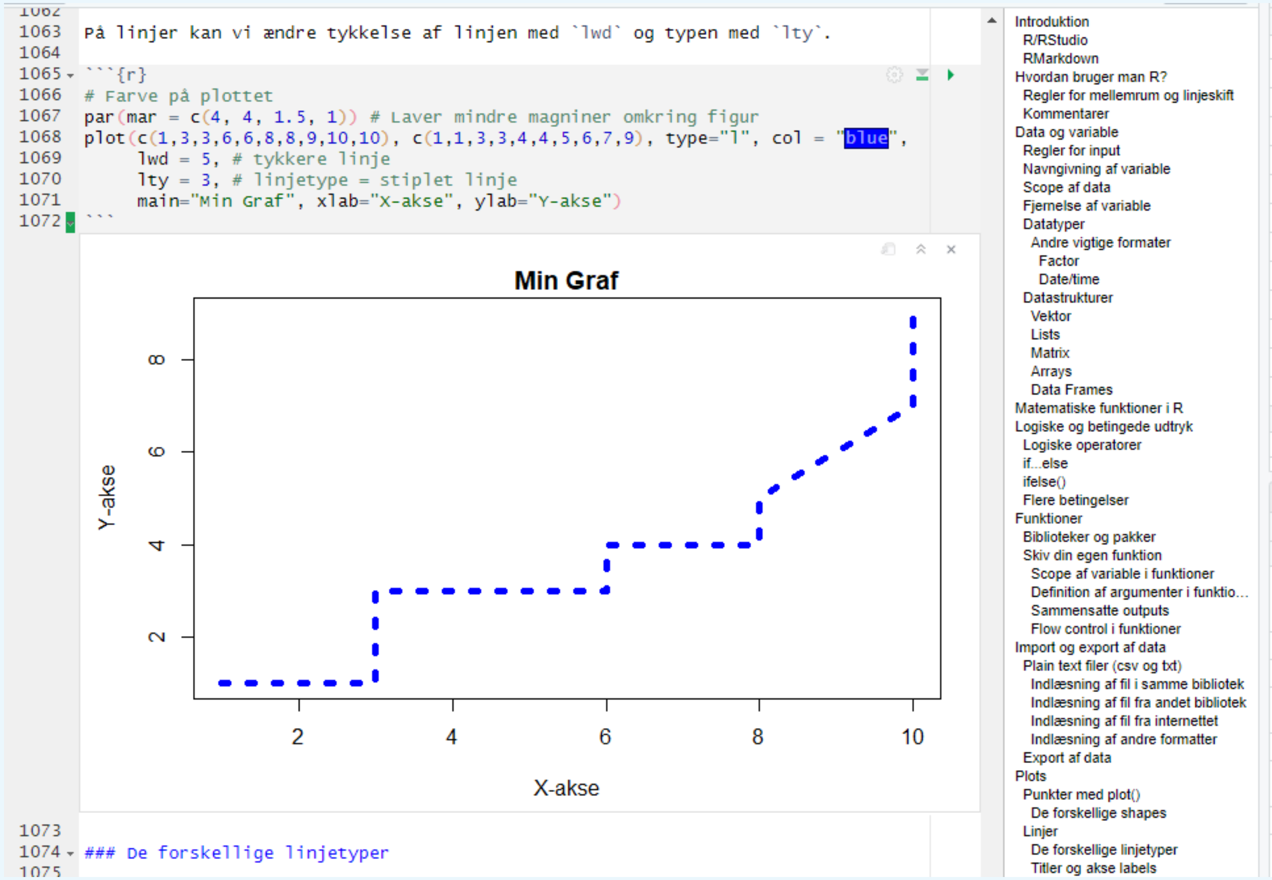
```
# Load all libraries used and set options
library(tidyverse)
library(lubridate)
library(ggtext)
library(pander)
library(patchwork)
panderOptions("table.style", "multiline")

### Data input ###
nfamRAW <- read.csv(file = "L:\\AuditData\\NFAM data\\NFAM_raw.csv", sep = ";")


### Data formatting ###
nfamData <- data.frame(id = 1:length(nfamRAW$ ID)) # Løbenummer
# Tilfældig transformering af CPR. Anvendes til identifikation af genindlæggelse
nfamData$ hashid <- as.numeric(nfamRAW$ hashid )
nfamData$ birth_year <- nfamRAW$ birth_year # Fødselsår
nfamData$ age <- nfamRAW$ age #Alder
nfamData$ gender <- factor(nfamRAW$ gender, levels = c("F","M")) # Køn (Admin)
# Angiver om forløbet er en genindlæggelse indenfor data perioden
nfamData$ readmission <- factor(nfamRAW$ X, levels = c("G"),
                                labels = c("Genindlagt"))
# Ankomst til AKA
nfamData$ arrival <- as.POSIXct(paste(nfamRAW$ arrival_date,
                                      nfamRAW$ arrival_time),
                                format = "%d-%m-%Y %H:%M:%S")
# Tidsinterval for ankomst til AKA
```

- Ren kode
- Koden køres i *Console* (Ctrl+Enter eller ‘Run’) Run
- Tekst kan sættes ind som kommentar, men *køres* ikke
- Kan anvendes i andre dokumenter via funktionen *source()*

R-Markdown fil



~~~
På linjer kan vi ændre tykkelse af linjen med `lwd` og typen med `lty`.

```{r}
# Farve på plottet
par(mar = c(4, 4, 1.5, 1)) # Laver mindre magniner omkring figur
plot(c(1,3,3,6,6,8,8,9,10,10), c(1,1,3,3,4,4,5,6,7,9), type="l", col = "blue",
     lwd = 5, # tykkere linje
     lty = 3, # linjetype = stiplet linje
     main="Min Graf", xlab="X-akse", ylab="Y-akse")
```
~~~

````
### De forskellige linjetyper
````

- Introduktion
  - R/RStudio
  - RMarkdown
- Hvordan bruger man R?
  - Regler for mellemrum og linjeskift
  - Kommentarer
- Data og variable
  - Regler for input
  - Navngivning af variable
  - Scope af data
  - Fjernelse af variable
  - Datatyper
    - Andre vigtige formater
      - Factor
      - Date/time
  - Datastrukturer
    - Vektor
    - Lists
    - Matrix
    - Arrays
    - Data Frames
- Matematiske funktioner i R
- Logiske og betingede udtryk
  - Logiske operatorer
  - if...else
  - ifelse()
  - Flere betingelser
- Funktioner
  - Biblioteker og pakker
  - Skiv din egen funktion
    - Scope af variable i funktioner
    - Definition af argumenter i funktio...
    - Sammensatte outputs
    - Flow control i funktioner
- Import og export af data
  - Plain text filer (csv og txt)
    - Indlæsning af fil i samme bibliotek
    - Indlæsning af fil fra andet bibliotek
    - Indlæsning af fil fra internettet
    - Indlæsning af andre formatter
  - Export af data
- Plots
  - Punkter med plot()
    - De forskellige shapes
  - Linjer
    - De forskellige linjetyper
    - Titler og akse labels

- Kombineret kode og tekst
- Kode indsættes i ‘*chunks*’
- Outputtet vises i samme vindue
- Kan knittes til et dokument

Syntaks

Funktioner består af et navn og en række argumenter, som skrives inde i parentesen

```
functionName(argument1, argument2, ...)
```

```
sample(x = 1:10, size = 100, replace=TRUE)
sample(1:10, 100, TRUE)
sample(replace=TRUE, size = 100, x = 1:10)
```

```
sample(TRUE, 100, 1:10)
Fejl i sample.int(length(x), size, replace,
prob): ugyldigt 'replace'-argument
```

```
# Uden mellemrum
seq(from=10,to=100,by=10)
## [1] 10 20 30 40 50 60 70 80 90 100
# Med mellemrum
seq ( from = 10, to = 100, by = 10)
## [1] 10 20 30 40 50 60 70 80 90 100

# Med linjeskift
seq(
  from=10,
  to=100,
  by=10)
## [1] 10 20 30 40 50 60 70 80 90 100
```

```
se q( from = 10, to = 100, by = 10)
Fejl: uventet symbol in "se q"
```

Pakker og biblioteker

R indeholder allerede en lang række basisfunktioner, som er klar til brug (kaldes *BaseR*)

Derudover findes der forskellige **biblioteker** (*Libraries*) med funktioner, som kan installeres via **pakker** (*packages*)

Pakker skal kun installeres én gang.

Men de enkelte biblioteker skal indlæses `library()` eller refereres `::` hver gang R startes op.

Installation af pakke

Via menu:

Tools → Install packages…
Skriv navnet i *Packages* feltet

Via console/kode

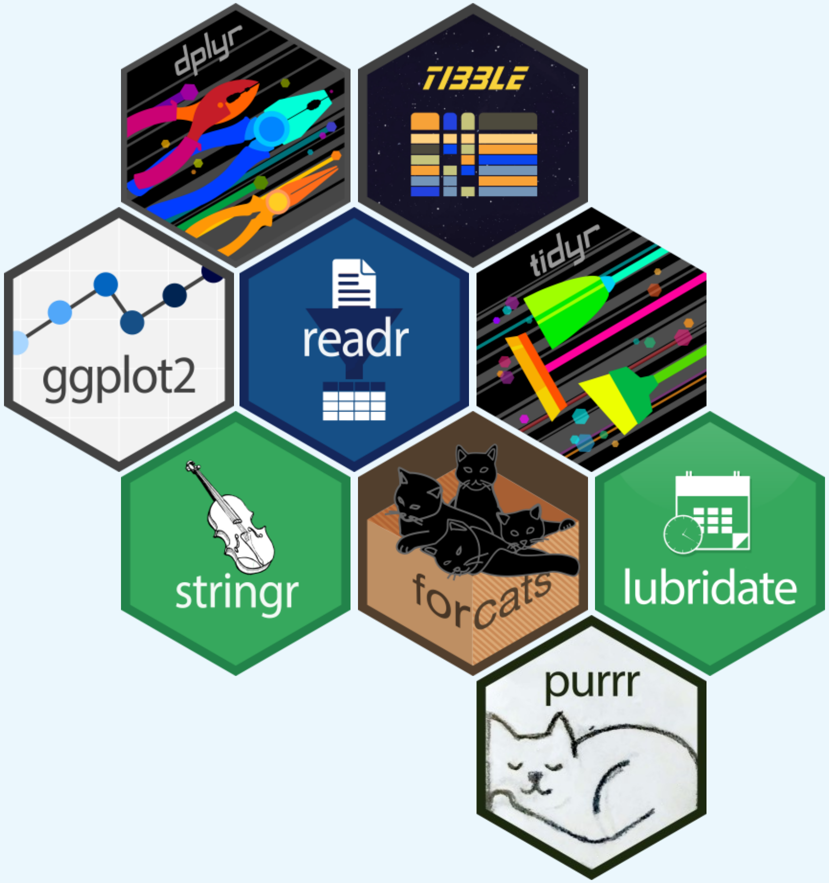
```
install.packages(”Tidyverse”)
```

Indlæsning af bibliotek

```
library(lunar)
```

```
lunar::lunar.phase(date, name=T)
```

Tidyverse



Pakke med forskellige biblioteker til datahåndtering og fremstilling

- **readr**: Værktøjer til indlæsning af datasæt fra forskellige formater
- **dplyr**: Værktøjer til datahåndtering
- **ggplot2**: Datavisualisering
- **tidyr**: Rensning af data
- **tibble**: Tabulering af data
- **stringr**: Værktøjer til string/tekst data
- **forcats**: Værktøjer til kategorisk data
- **lubridate**: Værktøjer til tid/dato data
- **purr**: Værktøjer til funktionel programmering

Data-input

Definition af data-variabel

```
myVariable <- "Hello World”
myVariable = "Hello World"
```

- Variablen skal have et **gyldigt navn**
- Tekst variable skal omsluttes af enkelt (’) eller dobbelt (“) citationstegn
- Heltal indtastes som de er
- Der kan kun bruges punktum som decimalseperator *(3.14195)*
- Konstanterne **`TRUE`** og **`FALSE`** bruges kun til logiske variable

Det er vigtigt at skelne mellem **NULL** og **NA**, da de håndteres meget forskelligt: **NULL** = *udefineret* element (Har ingen værdi), mens **NA** = manglende værdi.

Tilladte navne:

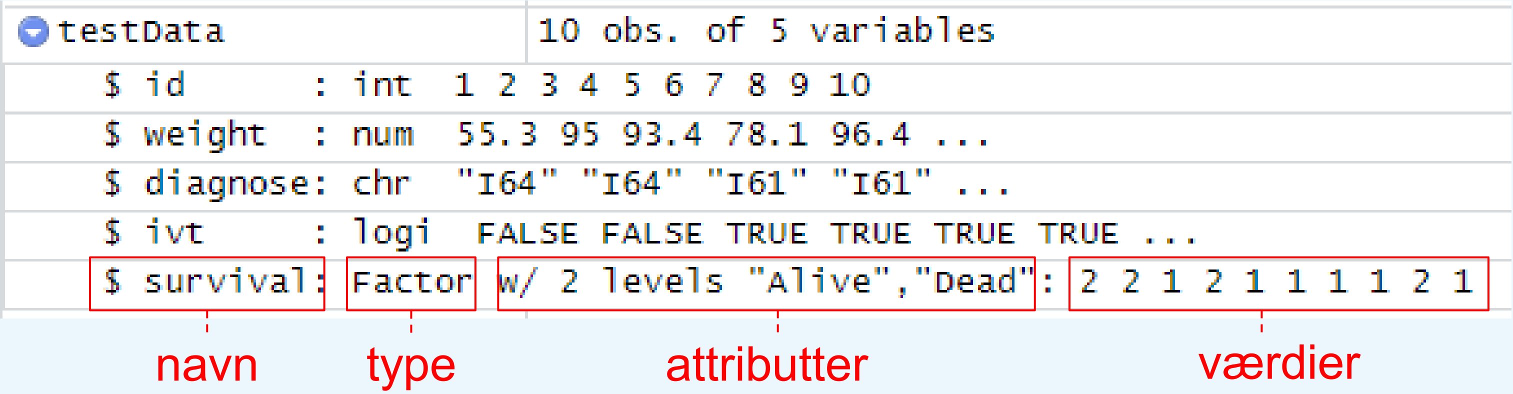
```
minvariabel <- "Værdi"
min_variabel <- "Værdi"
minVariabel <- "Værdi"
MINVARIABEL <- "Værdi"
minvariabel2 <- "Værdi"
.minvariabel <- "Værdi"
```

Forbudte navne:

```
2minvariabel <- "Værdi"
min-variabel <- "Værdi"
min variabel <- "Værdi"
_min_variabel <- "Værdi"
minv@ariabel <- "Værdi"
TRUE <- "Værdi"
```

Datatyper

`heltalVar <- 42`	Integer	Heltal
`decimalVar <- 3.14195`	Numeric	Decimaltal
`tekstVar <- "Tekst"`	Character	Tekst
`logiskVar <- TRUE`	Logical	Logiske værdier; Kan være enten TRUE / FALSE
`nullVar <- NULL`		Udefineret data
`naVar <- NA`		Manglende data / tomt felt
`factVar <- factor("Tekst")`	Factor	Kategorisk data



```
testData          10 obs. of 5 variables
   $ id      : int  1 2 3 4 5 6 7 8 9 10
   $ weight  : num  55.3 95 93.4 78.1 96.4 ...
   $ diagnose: chr  "I64" "I64" "I61" "I61" ...
   $ ivt     : logi  FALSE FALSE TRUE TRUE TRUE TRUE ...
   $ survival: Factor w/ 2 levels "Alive","Dead": 2 2 1 2 1 1 1 1 2 1
```

Datastrukturer

Datastrukturer er metoder til at organiserer data

Vektor: Samling af data af samme datatype i en dimension:

```
drikkevarer <- c("vand","kaffe","te")
```

Lists: Samling af data af forskellig datatype i en dimension:

```
minListe <- list("kaffe","vand", 42,
TRUE)
```

Matrix: Samling af data af samme datatype i to dimensioner:

```
minMatrix <- matrix(c(1,2,3,4,5,6),
nrow = 3, ncol = 2)
```

Dataframe: Datastruktur, der består af sammenhængende vektorer

```
minDataFrame <- data.frame (
     patientnr = c(1, 2, 3, 4,
       5, 6, 7, 8),
     diagnose = c("I61", "I61",
       "I61", "I64", "I64",
       "I63", "I64", "I61"),
     sysBT = c(142, 165, 153,
       120, 145, 168,
       165, 133),
     køn = factor(c(1, 1, 2, 1,
       2, 2, 2, 1),
       labels = c("Mand", "Kvinde")
       ))
```

Matematiske operatorer

Simple operatorer

```
5 + 5
## [1] 10
5 - 5
## [1] 0
5 * 5
## [1] 25
5 / 5
## [1] 1
```

Regning med elementer

```
tal <- 8
tal + 10
## [1] 18
```

Indbyggede matematiske funktioner

```
sqrt(100)
## [1] 10
4^2
## [1] 16
log(2)
## [1] 0.6931472
exp(1)
## [1] 2.718282
sum(2,18,5)
## [1] 25
```

Logiske operatorer

```
10 < 12 # TRUE fordi 10 er mindre end 12
## [1] TRUE

10 <= 12 # TRUE fordi 10 er mindre end ELLER lig med 12
## [1] TRUE

10 > 12 # FALSE fordi 10 ikke er større end 12
## [1] FALSE

10 >= 12 # FALSE fordi 10 ikke er større end ELLER lig med 12
## [1] FALSE

10 == 12 # FALSE fordi 10 ikke er lig med 12
## [1] FALSE

10 != 12 # TRUE fordi 10 ikke er lig med 12
## [1] TRUE
```

If…else funktioner

```
a <- 10
b <- 12

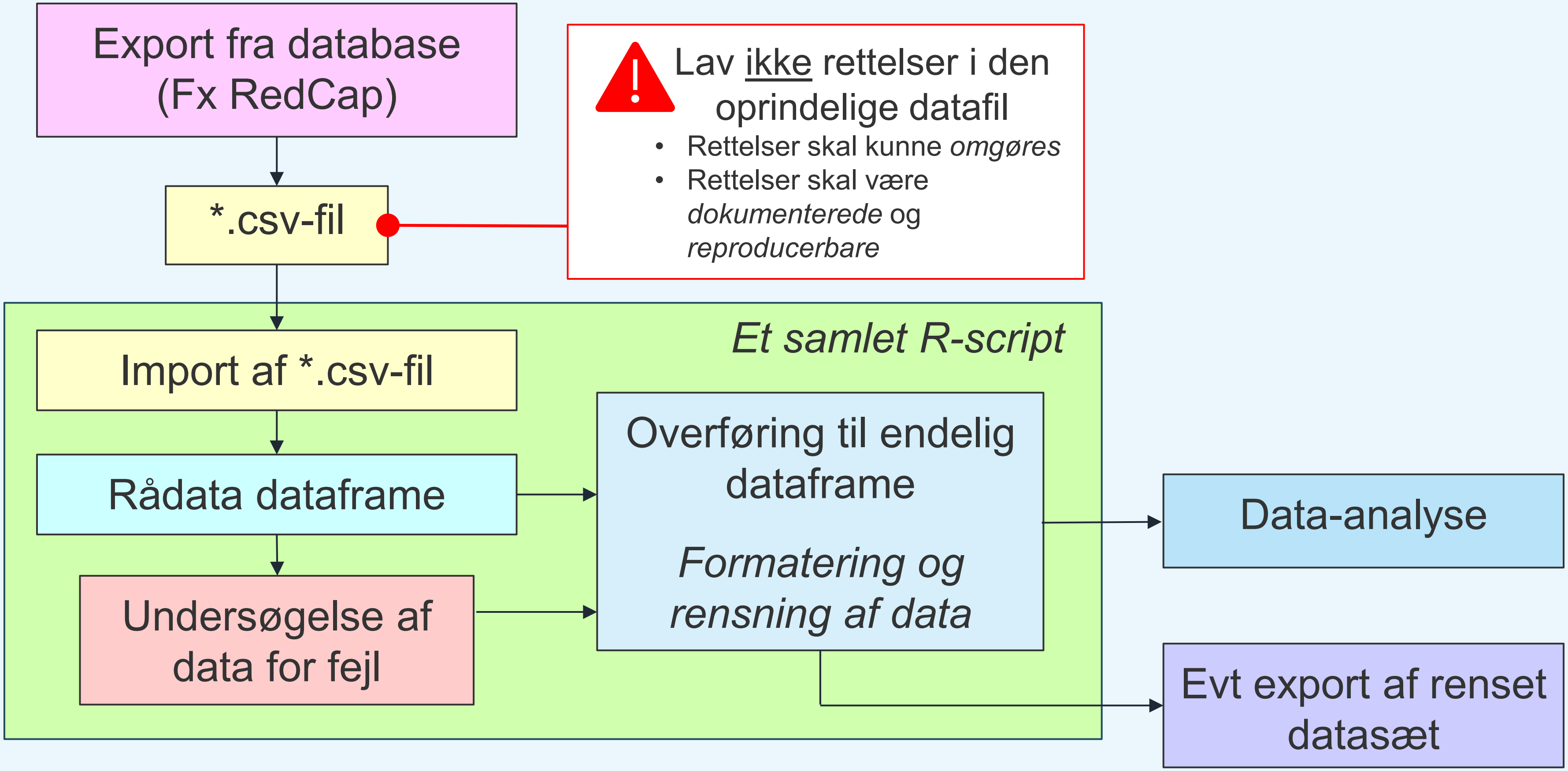
if (a < b){
print("a er mindre end b")
} else {
print("a er større end b") }
## [1] "a er mindre end b"
```

```
a <- 7562

ifelse(a > 1000, "Ja", "Nej")
## [1] "Ja"
```

```
a <- 1000
b <- 25
c <- 756
if(a > b & a > c){ print("begge betingelser er opfyldt") }
## [1] "begge betingelser er opfyldt"
if(a > b | a > c){ print("mindst en betingelse er opfyldt") }
## [1] "mindst en betingelse er opfyldt"
```

Klargøre af data til analyse



Export fra database (Fx RedCap)

*.csv-fil

⚠ Lav ikke rettelser i den oprindelige datafil

- Rettelser skal kunne *omgøres*
- Rettelser skal være *dokumenterede* og *reproducerbare*

Et samlet R-script

Import af *.csv-fil

Rådata dataframe

Undersøgelse af data for fejl

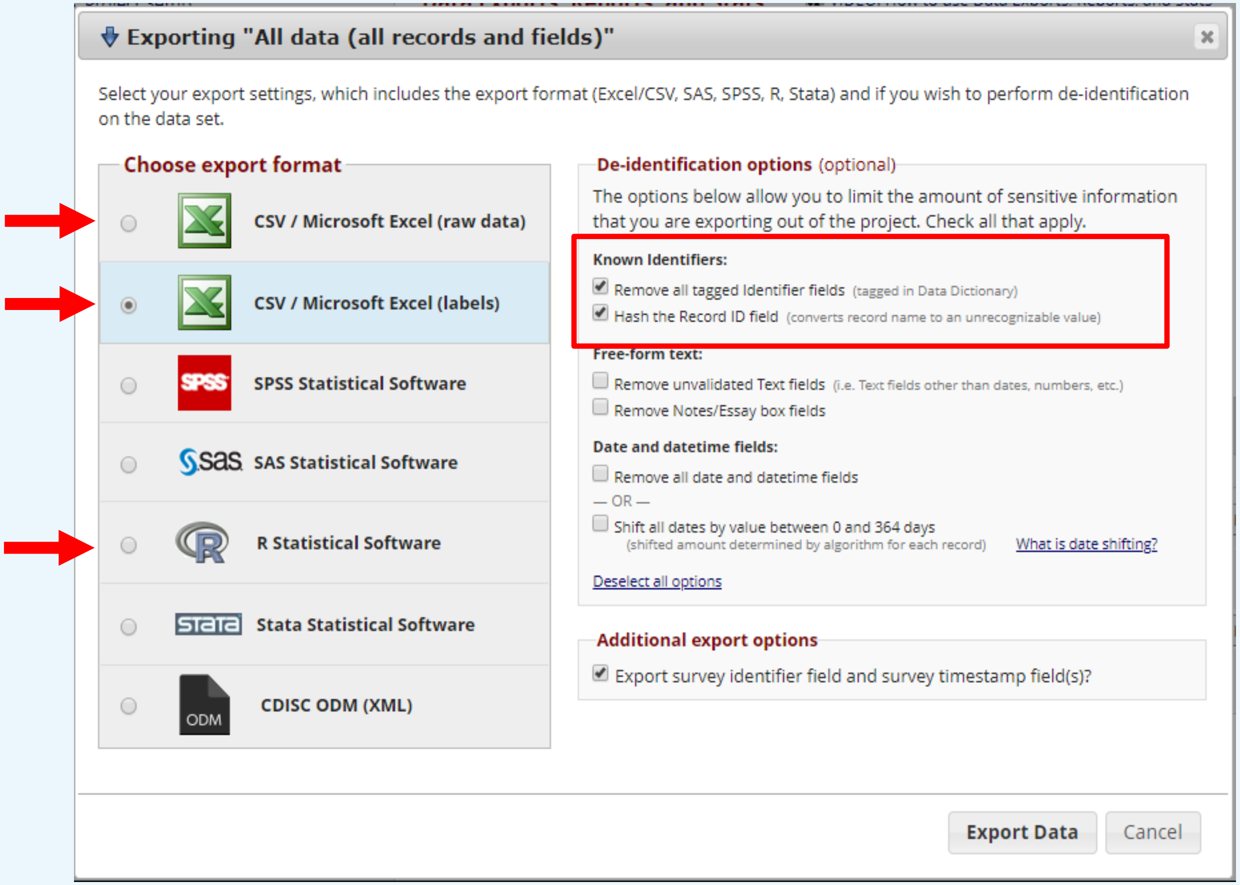
Overføring til endelig dataframe

Formatering og rensning af data

Data-analyse

Evt export af renset datasæt

Export fra RedCap



Exporting "All data (all records and fields)"

Select your export settings, which includes the export format (Excel/CSV, SAS, SPSS, R, Stata) and if you wish to perform de-identification on the data set.

Choose export format

- ○ CSV / Microsoft Excel (raw data)
- ● CSV / Microsoft Excel (labels)
- ○ SPSS Statistical Software
- ○ SAS Statistical Software
- ○ R Statistical Software
- ○ Stata Statistical Software
- ○ CDISC ODM (XML)

De-identification options (optional)

The options below allow you to limit the amount of sensitive information that you are exporting out of the project. Check all that apply.

Known Identifiers:

☑ Remove all tagged Identifier fields (tagged in Data Dictionary)
☑ Hash the Record ID field (converts record name to an unrecognizable value)

Free-form text:

☐ Remove unvalidated Text fields (i.e. Text fields other than dates, numbers, etc.)
☐ Remove Notes/Essay box fields

Date and datetime fields:

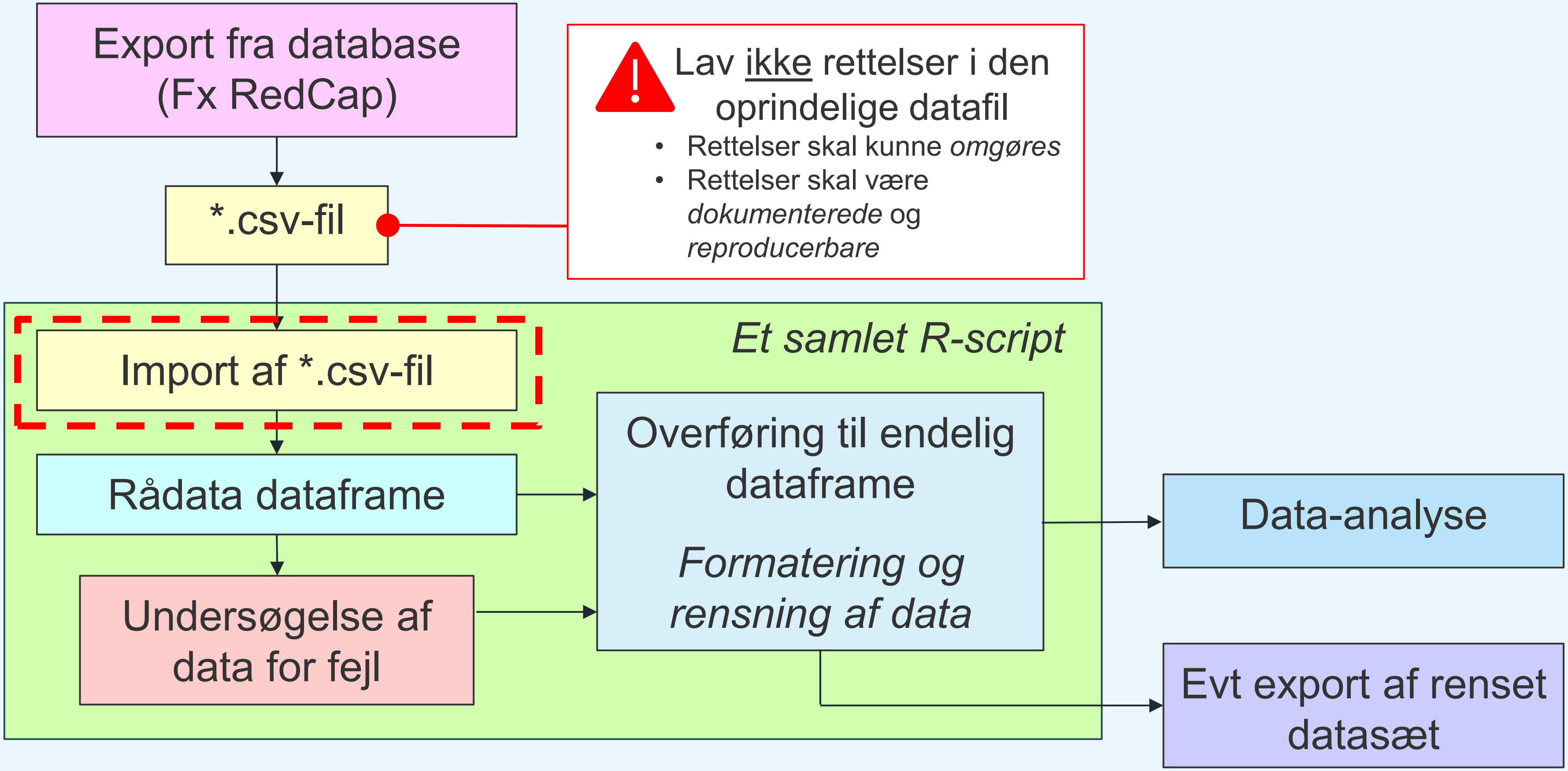
☐ Remove all date and datetime fields
— OR —
☐ Shift all dates by value between 0 and 364 days
(shifted amount determined by algorithm for each record) What is date shifting?

Deselect all options

Additional export options

☑ Export survey identifier field and survey timestamp field(s)?

Klargøre af data til analyse



Export fra database (Fx RedCap)

*.csv-fil

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- Rettelser skal være *dokumenterede* og *reproducerbare*

Et samlet R-script

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Evt export af renset datasæt

Indlæsning af data

Indlæsning af *.csv-fil

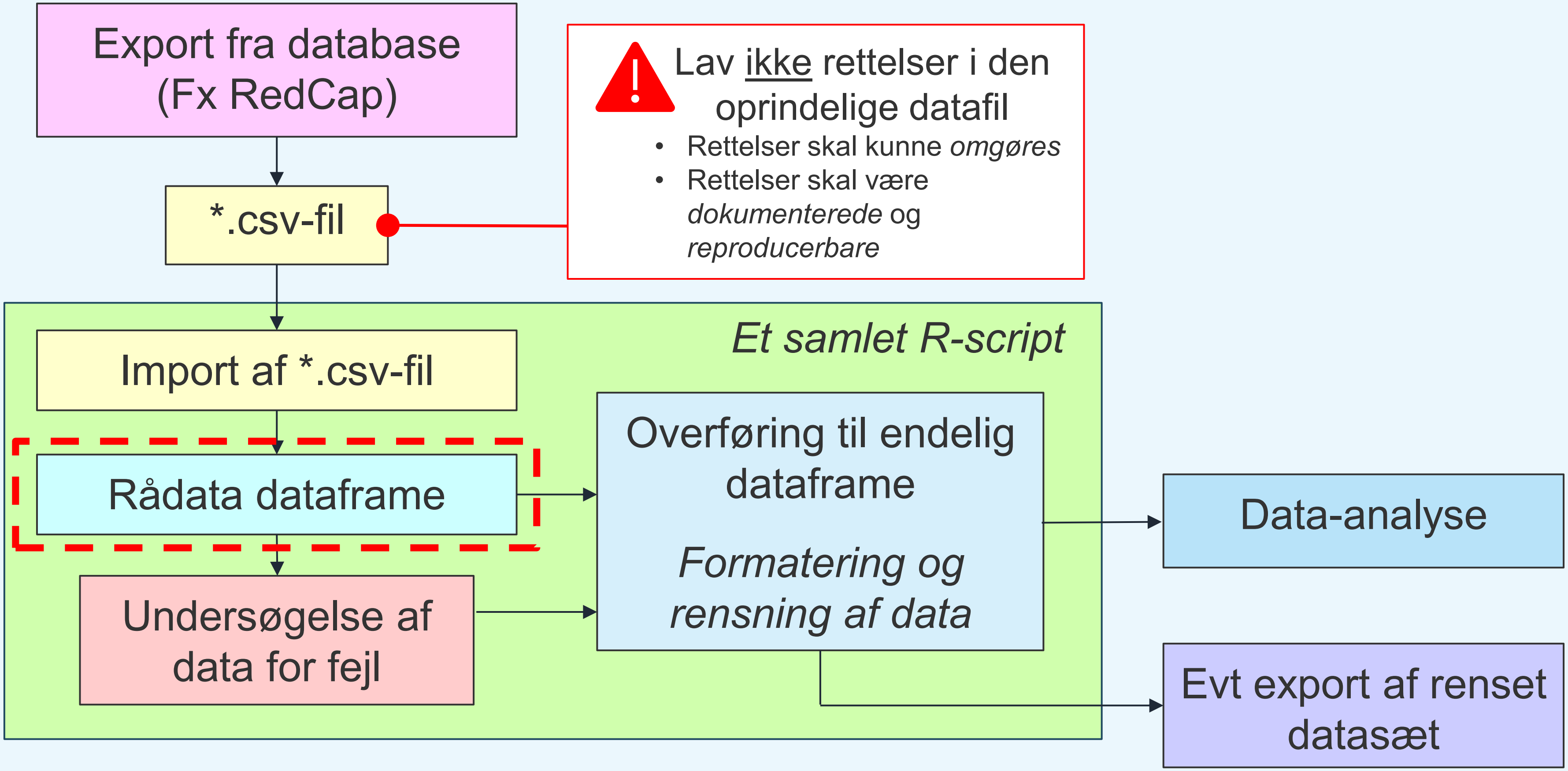
```
# Indlæsning af fil i engelsk formatering
strokedf <- read.csv("strokedata.csv")
# Indlæsning af fil i dansk formatering, altså
# semikolon mellem værdier og komma som decimal separator
strokedf <- read.csv("strokedata_dk.csv", sep=";", dec = ",")
```

```
# Indlæsning af fil fra et fælles drev
strokedf <- read.csv("L:\\AuditData\\ApoData\\strokedata.csv")
```

Indlæsning fra web-side

```
strokedf <-
read.csv("https://jacobliljehult.github.io/research/strokedata.csv",
sep=",", header=T, stringsAsFactors = TRUE)
```

Klargøre af data til analyse



Export fra database (Fx RedCap)

*.csv-fil

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- Rettelser skal kunne *omgøres*
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Et samlet R-script

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Evt export af renset datasæt

Dataflow

NFAMstart.R

```r
# Load all libraries used
library(tidyverse)
library(lubridate)
### Data input ###
nfamRAW <- read.csv(file =
"L:\\AuditData\\NFAM data\\NFAM_raw.csv",
sep = ";")

### Data formatting ###
nfamData <- data.frame(id =
1:length(nfamRAW$ ID)) # Løbenummer
nfamData$ age <- nfamRAW$ age #Alder
nfamData$ gender <- factor(nfamRAW$
gender, levels = c("F","M")) # Køn (Admin)
# Ankomst til AKA
nfamData$ arrival <-
as.POSIXct(paste(nfamRAW$ arrival_date,
nfamRAW$ arrival_time),
format = "%d-%m-%Y %H:%M:%S")
rm(nfamRAW) # Fjerner rådata
```

NFAM_rapport.Rmd

~~~
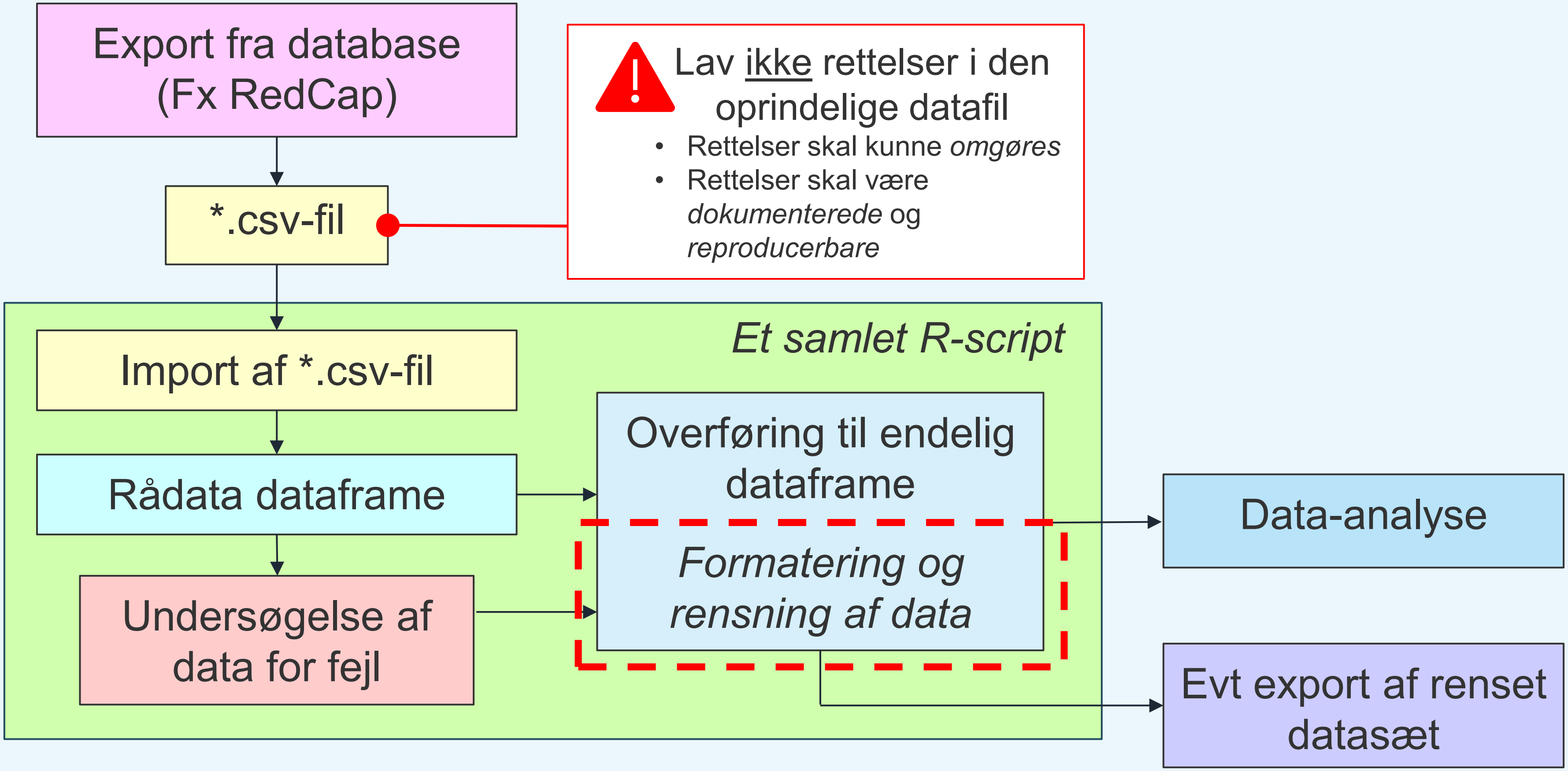
```{r}
source(”NFAMstart.R”)
```


# Patientgrundlag
Siden 4. septemter har der været `r
length(nfamData$id)` neurologiske
patientforløb i AKA.

```{r}
nfamData %>% select(npathway_bed,
destination,destination_ward) %>%
filter(!is.na(npathway_bed) &
!is.na(destination_ward)) %>%
mutate(grp = factor(paste( npathway_bed,
"|",destination_ward))) %>%
group_by(grp) %>% summarise(Antal = n())
%>% mutate(Procent = paste( round(
Antal/sum(Antal)*100,1),"%"))
```
~~~

Klargøre af data til analyse



Export fra database (Fx RedCap)

*.csv-fil

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Evt export af renset datasæt

Struktur af datasæt

```r
str(testData)
```

```
## 'data.frame': 100 obs. of 11 variables:
## $ id : int 1 2 3 4 5 6 7 8 9 10 ...
## $ hospital : Factor w/ 5 levels "NOH","BBH","HGH",..: 2 4 3 1 4 3 3 3 5 2 ...
## $ admission : POSIXct, format: "2024-01-04 15:02:00" "2024-01-18 13:50:00" ...
## $ discharge : POSIXct, format: "2024-01-12 16:35:00" "2024-01-26 15:44:00" ...
## $ gender : Factor w/ 2 levels "F","M": 2 2 1 1 2 2 1 1 1 1 ...
## $ age : num 66 65 60 53 88 55 68 69 59 72 ...
## $ height : num 183 169 173 184 177 191 162 162 163 155 ...
## $ weight : num 86.6 72.5 34.7 53.2 76 ...
## $ allocation: Factor w/ 2 levels "Control","Treatment": 2 2 2 2 2 1 1 2 1 1 ...
## $ sbp_pre : num 151 127 146 137 141 152 148 122 144 137 ...
## $ sbp_post : num 144 120 144 128 137 151 151 119 146 135 ...
```

navn type værdier

Formatering af datatyper

```
# Formattering af numeriske værdier
testData$age <- as.numeric(testDataRaw$age)

# Formattering af heltal
testData$age <- as.integer(testDataRaw$age)

# Formattering af tekst
testData$hospital <- as.character(testDataRaw$hospital)

# Formattering af factor fra tekstvariabel
testData$gender <- as.factor(testDataRaw$gender)

# Formattering af factor med labels
testData$hospital <- as.factor(testDataRaw$hospital,
        levels = c(1,2,3,4,5),
        labels = c("NOH", "BBH", "HGH", "AHH", "RH"))
```

Formatering af dato og tid

Dato

Tekstformat: `"2024-01-04"`

```
as.POSIXct(testDataRaw$admission_date, format = "%Y-%m-%d")
```

```
lubridate::ymd(testDataRaw$admission_date)
```

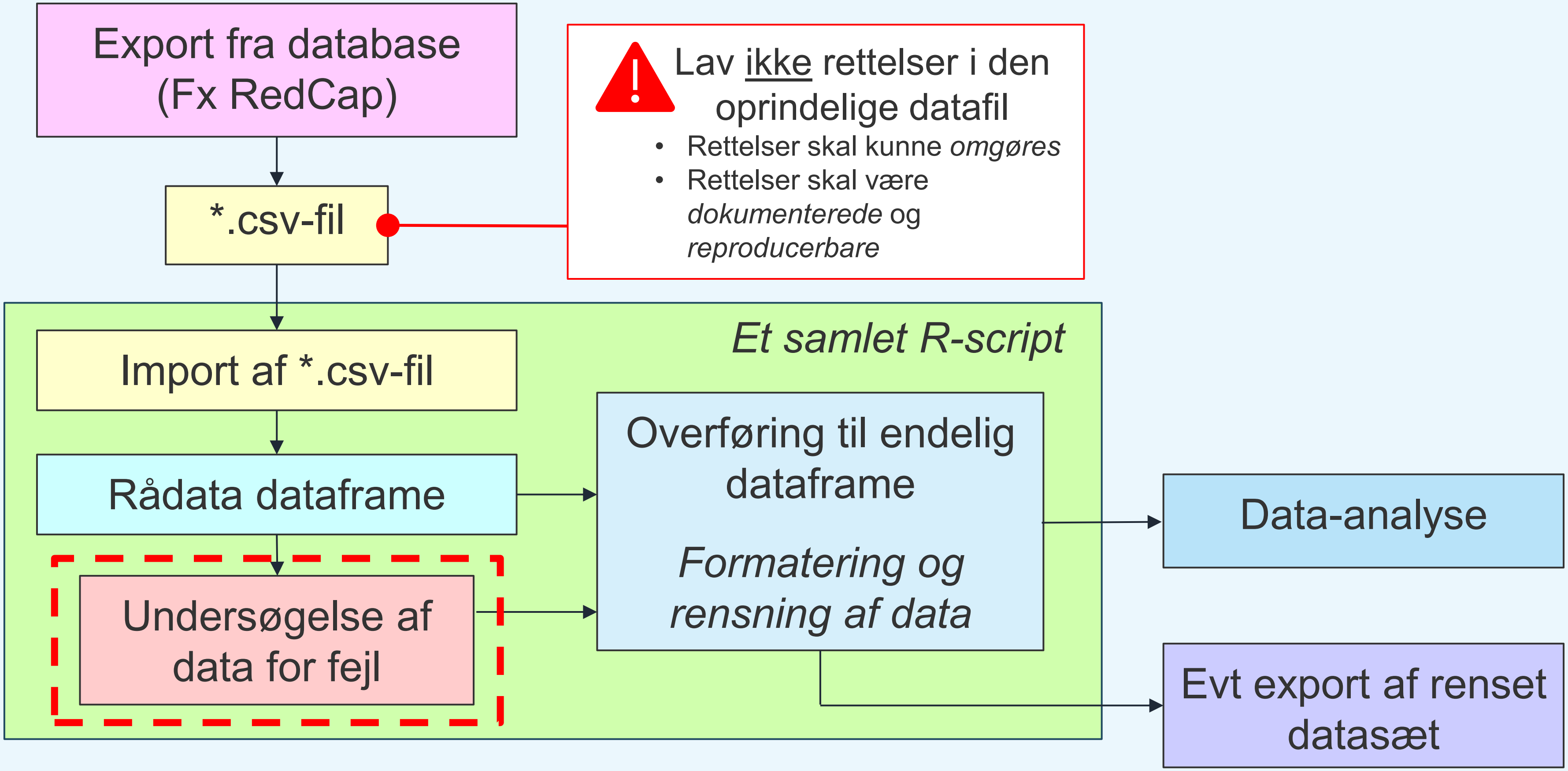
Dato + tid

Tekstformat: `"2024-01-04 10:35"`

```
as.POSIXct(testDataRaw$admission, format = "%Y-%m-%d %H:%M")
```

```
lubridate::ymd_hm(testDataRaw$admission)
```

Klargøre af data til analyse



Export fra database (Fx RedCap)

*.csv-fil

Lav ikke rettelser i den oprindelige datafil

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Et samlet R-script

Import af *.csv-fil

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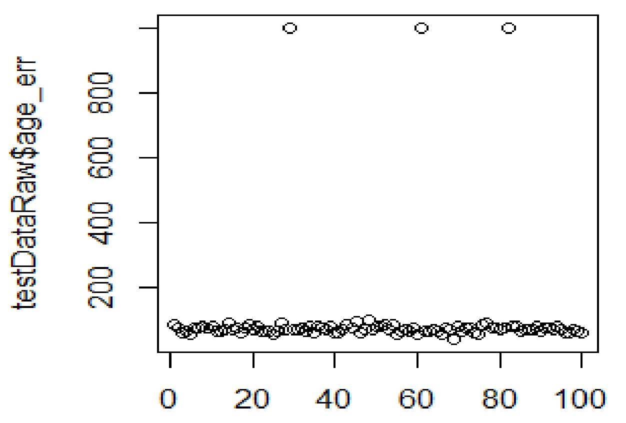
Evt export af renset datasæt

Undersøgelse for ekstreme værdier

```r
summary(testDataRaw$age_err)
```

```
## Min.     1st Qu.    Median    Mean     3rd Qu.    Max.
## 45.00    64.00      69.00     96.43    74.50      999.00
```

```r
plot(testDataRaw$age_err)
```



Rettelse af ekstreme værdier til NA

```r
ifelse(testDataRaw$age_err != 999, testDataRaw$age_err, NA)
```

Forkerte kategorier

```
unique(testDataRaw$gender_err)
```

```
## [1] 1 0 2
```

```
table(testDataRaw$gender_err)
```

```
## 0  1  2
## 39 53 8
```

```
table(testDataRaw$gender_err, testDataRaw$hospital)
```

```
##     NOH BBH HGH AHH RH
## 0   8   11  7   13  0
## 1   12  9   13  7   12
## 2   0   0   0   0   8
```

Betinget rettelse af værdier

```
ifelse(testDataRaw$hospital == ”RH”,
       ifelse(testDataRaw$gender_err == 1, 0, 1) ,
       testDataRaw$gender_err)
```

Fejl i decimaltegn

```
testDataRaw$ weight_err
```

```
## [1] "86,65" "72,5" "34,69" "53,17" "76,03" "100,65" "64,01" "53,79"
```

```
testData$ weight_err <- as.numeric(testDataRaw$ weight_err)
```

```
## Warning: NAs introduced by coercion
```

Rettelse af tegn i tekst + formatering til tal

```
testData$ weight_err <- as.numeric(
                   gsub(",", ".", testDataRaw$ weight_err) )
```

Forkert kodning af NA-værdi

```
unique(testDataRaw$ height_err)
```

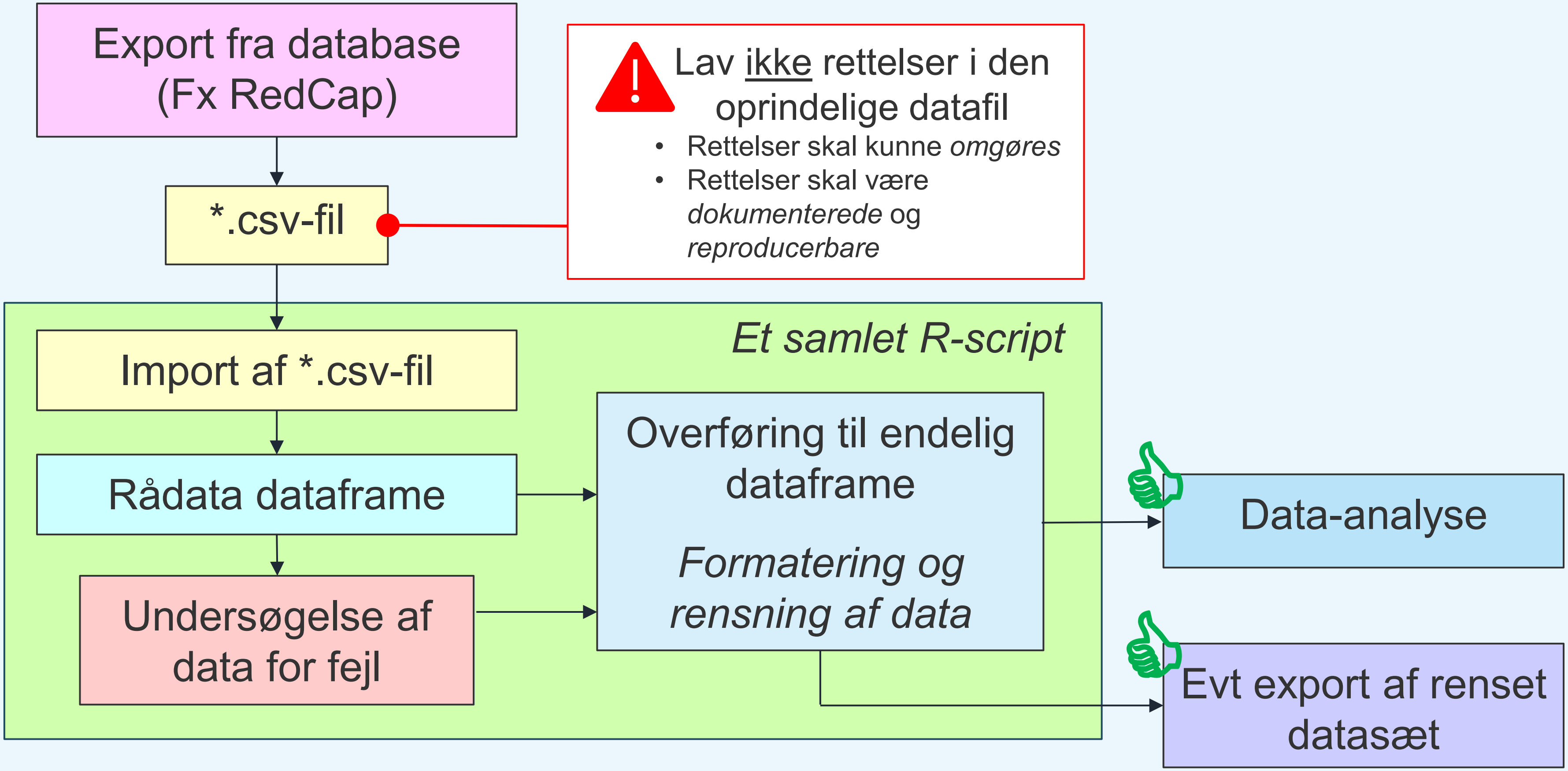
```
## [1] "183" "169" "173" "184" "177" "191" "162" "." "163" "155" "164" "189"
```

Rettelse af manglende værdi

```
testData$ height_err <- as.numeric(testDataRaw$ height_err)
```

```
## Warning: NAs introduced by coercion
## [1] 183 169 173 184 177 191 162 NA 163 155 164 189 168 184 171
```

Klargøre af data til analyse



Export fra database (Fx RedCap)

*.csv-fil

Lav ikke rettelser i den oprindelige datafil

- Rettelser skal kunne *omgøres*
- Rettelser skal være *dokumenterede* og *reproducerbare*

Et samlet R-script

Import af *.csv-fil

Rådata dataframe

Undersøgelse af data for fejl

Overføring til endelig dataframe

Formatering og rensning af data

Data-analyse

Evt export af renset datasæt

Deskriptiv statistik

Kvantitative data

```
summary(strokedata$age)

 Min.  1st Qu.  Median   Mean  3rd Qu.   Max.
21.00   64.00   73.00   71.85   81.00   99.00
```

Konfidensinterval

En nem måde at udregne et konfidensinterval for en kontinuert variable er at lave en *one-sample t-test* mod variablens eget gennemsnit

```
t.test(strokedata$age,
       mu = mean(strokedata$age)
       )$conf.int[1:2]
[1] 71.09142 72.60984
```

`length(x)`	længden af en variabel
`mean(x)`	gennemsnit
`median(x)`	median
`min(x)`	mindste værdi
`max(x)`	maksimal værdi
`range(x)`	range
`var(x)`	variation
`sd(x)`	standard deviation
`quantile(x, p)`	percentiler

Argumentet `na.rm = TRUE` kan bruges til at ignorere NA værdier

Deskriptiv statistik

Kategorisk data

Enkel variabel

```
table(strokedata$inhospmors)
Alive Dead
  971   60
```

2 x 2 tabel *(Absolutte tal)*

```
with(strokedata,
    table(diagnosis, inhospmors))
inhospmors
diagnosis Alive Dead
      ICH    88   22
      IS    883   38
```

2 x 2 tabel *(procent)*

```
with(strokedata,
    prop.table(
    table(diagnosis, inhospmors)))
          inhospmors
diagnosis      Alive       Dead
      ICH 0.08535403 0.02133851
       IS 0.85645005 0.03685742
```

→

```
# Procent for rækker
with(df, prop.table(table(x, y) ,1))
# Procent for koloner
with(df, prop.table(table(x, y) ,2))
```

Konfidensinterval

Konfidensintervaller for proportioner kan udregnes med funktionerne `prop.test()` eller `binom.test()`

```
prop.test(75, 100,
    conf.level = 0.95)$conf.int[1:2]
[1] 0.6516159 0.8288245
```

Slides

Scan mig

http://jacobliljehult.github.io/research/