

Introduction to R 2025

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Part I

Introduction

Chapter 1

Workshop Info

Welcome to the 2025 Introduction to R Canadian Bioinformatics Workshop webpage!

1.1 Pre-work

You can find your pre-work here.

1.2 Class Photo

1.3 Schedule

Chapter 2

Meet Your Faculty

2.0.0.1 Mohamed Helmy

Principal Scientist and Adjunct Professor Vaccine and Infectious Disease Organization (VIDO), University of Saskatchewan Saskatoon, Saskatchewan, Canada

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Mohamed is a Computational Systems Biologist and Principal Scientist leading the Bioinformatics and Systems Biology Lab (BSBL) at the Vaccine and Infectious Disease Organization (VIDO), University of Saskatchewan. He received his MSc and PhD in Computational Systems Biology from Keio University (Tokyo, Japan) and completed his postdoctoral training in bioinformatics at Kyoto University and the University of Toronto. Mohamed's interdisciplinary research profile bridges biology, computer science, and public health.

2.0.0.2 Sylvia Li

Graduate student Vaccine and Infectious Disease Organization (VIDO), University of Saskatchewan Saskatoon, Saskatchewan, Canada

Sylvia is a Computer science MSc student at the University of Saskatchewan, supervised by Dr. Helmy. She holds dual BSc degrees in Bioinformatics and Computer science. Currently her work focuses on bacterial genomic data.

Data and Compute Setup

2.0.0.3 Course data downloads

Coming soon!

2.0.0.4 Compute setup

Coming soon!

Part II

Modules

Chapter 3

Module 1

3.1 Lecture

3.1.1 1A

3.1.2 1B

3.2 Lab 1A

3.2.1 Variables

Create 2 numeric variables and assign values for each

```
x = 10  
y = 6
```

Calculate the sum of them

```
total = x + y  
total
```

```
## [1] 16
```

Calculate the square root of the total

```
sr = sqrt(total)
sr
```

```
## [1] 4
```

3.2.2 Data Structures

Vector

```
v <- c(1,2,3,4)
v
```

```
## [1] 1 2 3 4
```

Matrix

```
m <- matrix(1:6, nrow = 2)
m
```

```
##      [,1] [,2] [,3]
## [1,]    1    3    5
## [2,]    2    4    6
```

Dataframe

```
df <- data.frame(age=c(25,30), name=c("Mo","Tom"), group=c("A", "B"))
df
```

```
##   age name group
## 1  25   Mo     A
## 2  30  Tom     B
```

List

```
lst <- list(numbers=v, info=df)
lst
```

```
## $numbers
## [1] 1 2 3 4
##
## $info
##   age name group
## 1  25   Mo     A
## 2  30  Tom     B
```

3.3 Lab 1B

3.3.1 Install Bioconductor packages

```
install.packages("BiocManager")
BiocManager::install("ALL")
```

3.3.2 View patient metadata

```
library(BiocManager)
library(ALL)
data(ALL)
df2 <- pData(ALL)
```

3.3.3 Quick summary

```
#summary(pData(ALL)[, c("age", "sex", "BT", "relapse")])
summary(df2[, c("age", "sex", "BT", "relapse")])
```

```
##      age      sex      BT      relapse
## Min.   : 5.00   F   :42   B2    :36   Mode :logical
## 1st Qu.:19.00   M   :83   B3    :23   FALSE:35
## Median :29.00  NA's: 3   B1    :19   TRUE :65
## Mean   :32.37                T2    :15   NA's :28
## 3rd Qu.:45.50                B4    :12
## Max.   :58.00                T3    :10
## NA's    :5                  (Other):13
```

3.3.4 str() and dim() functions

```
dim(df2)
```

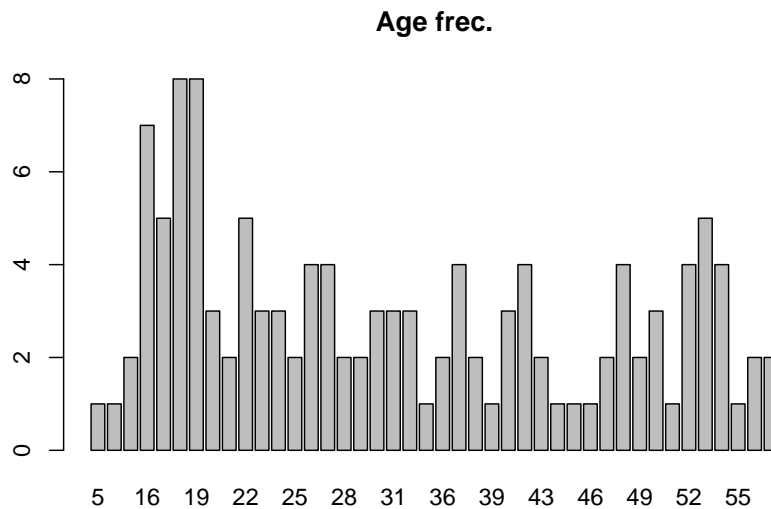
```
## [1] 128 21
```

```
str(df2)
```

```
## 'data.frame':    128 obs. of  21 variables:
## $ cod           : chr  "1005" "1010" "3002" "4006" ...
## $ diagnosis     : chr  "5/21/1997" "3/29/2000" "6/24/1998" "7/17/1997" ...
## $ sex           : Factor w/ 2 levels "F","M": 2 2 1 2 2 2 1 2 2 2 ...
## $ age           : int   53 19 52 38 57 17 18 16 15 40 ...
## $ BT            : Factor w/ 10 levels "B","B1","B2",...: 3 3 5 2 3 2 2 2 3 3 ...
## $ remission     : Factor w/ 2 levels "CR","REF": 1 1 1 1 1 1 1 1 1 1 ...
## $ CR            : chr   "CR" "CR" "CR" "CR" ...
## $ date.cr       : chr   "8/6/1997" "6/27/2000" "8/17/1998" "9/8/1997" ...
## $ t(4;11)       : logi   FALSE FALSE NA TRUE FALSE FALSE ...
## $ t(9;22)       : logi   TRUE  FALSE NA FALSE FALSE FALSE ...
## $ cyto.normal   : logi   FALSE FALSE NA FALSE FALSE FALSE ...
## $ citog         : chr   "t(9;22)" "simple alt." NA "t(4;11)" ...
## $ mol.biol      : Factor w/ 6 levels "ALL1/AF4","BCR/ABL",...: 2 4 2 1 4 4 4 4 4 2 ...
## $ fusion.protein: Factor w/ 3 levels "p190","p190/p210",...: 3 NA 1 NA NA NA NA NA ...
## $ mdr           : Factor w/ 2 levels "NEG","POS": 1 2 1 1 1 1 2 1 1 1 ...
## $ kinet         : Factor w/ 2 levels "dyploid","hyperd.": 1 1 1 1 1 2 2 1 1 NA ...
## $ ccr           : logi   FALSE FALSE FALSE FALSE FALSE FALSE ...
## $ relapse       : logi   FALSE TRUE TRUE TRUE TRUE TRUE ...
## $ transplant    : logi   TRUE  FALSE FALSE FALSE FALSE FALSE ...
## $ f.u           : chr   "BMT / DEATH IN CR" "REL" "REL" "REL" ...
## $ date last seen: chr   NA "8/28/2000" "10/15/1999" "1/23/1998" ...
```

3.3.5 the table() function

```
af <- table(df2$age)
barplot(af, main = "Age freq.")
```

mean and median age

```
mn <- mean(df2$age) # this will return NA
md <- median(df2$age) # this will return NA

mn <- mean(df2$age, na.rm = TRUE) # this will work
md <- median(df2$age, na.rm = TRUE) # this will work
```

3.3.6 standard deviation and variance

```
std <- sd(df2$age, na.rm = TRUE)
vr <- var(df2$age, na.rm = TRUE)
```

3.3.7 Extremes

```
mxx <- max(df2$age, na.rm = T)
mnn <- min(df2$age, na.rm = T)
```

3.3.8 Table and (Frequency)

```
age_dit <- table(df2$age)
```

3.3.9 Quick summary

```
summary(df2[, c("age", "sex", "BT", "relapse")])
```

```
##      age      sex      BT      relapse
## Min.   : 5.00    F    :42    B2     :36    Mode :logical
## 1st Qu.:19.00    M    :83    B3     :23    FALSE:35
## Median :29.00   NA's: 3    B1     :19    TRUE :65
## Mean   :32.37                    T2     :15    NA's :28
## 3rd Qu.:45.50                    B4     :12
## Max.   :58.00                    T3     :10
## NA's    :5                      (Other):13
```

3.3.10 Patients older than 40

```
older_patients <- subset(df2, age > 40)
```

3.3.11 Patients who relapsed

```
relapsed_patients <- subset(df2, relapse == TRUE)
```

3.3.12 Subsetting and Filtering

3.3.12.1 subset()

```
subset(df2, age > 40 & relapse == TRUE)
```

| ## | cod | diagnosis | sex | age | BT | remission | CR | date.cr | t(4;11) | t(9;22) | |
|----|-------------|------------|------------|---------------|-------|------------|--------|------------|---------|---------|-------|
| ## | 03002 | 3002 | 6/24/1998 | F | 52 | B4 | CR CR | 8/17/1998 | NA | NA | |
| ## | 04007 | 4007 | 7/22/1997 | M | 57 | B2 | CR CR | 9/17/1997 | FALSE | FALSE | |
| ## | 08012 | 8012 | 10/22/1998 | M | 55 | B3 | CR CR | 1/9/1999 | FALSE | FALSE | |
| ## | 15004 | 15004 | 2/10/2000 | M | 44 | B1 | CR CR | 4/3/2000 | TRUE | FALSE | |
| ## | 16004 | 16004 | 4/19/1997 | F | 58 | B1 | CR CR | 7/15/1997 | TRUE | FALSE | |
| ## | 19005 | 19005 | 11/15/1997 | F | 48 | B1 | CR CR | 2/3/1998 | FALSE | FALSE | |
| ## | 20002 | 20002 | 5/9/1997 | F | 58 | B2 | CR CR | 8/19/1997 | FALSE | TRUE | |
| ## | 24005 | 24005 | 1/3/1997 | F | 45 | B1 | CR CR | 4/8/1997 | TRUE | FALSE | |
| ## | 24017 | 24017 | 9/15/1998 | M | 57 | B2 | CR CR | 12/7/1998 | FALSE | TRUE | |
| ## | 26003 | 26003 | 2/18/1998 | F | 49 | B4 | CR CR | 4/21/1998 | FALSE | FALSE | |
| ## | 28028 | 28028 | 7/8/1998 | M | 47 | B1 | CR CR | 9/3/1998 | TRUE | FALSE | |
| ## | 28036 | 28036 | 12/23/1998 | M | 52 | B3 | CR CR | 3/8/1999 | FALSE | TRUE | |
| ## | 43001 | 43001 | 11/14/1996 | M | 41 | B1 | CR CR | 1/30/1997 | FALSE | TRUE | |
| ## | 49006 | 49006 | 8/12/1998 | F | 43 | B2 | CR CR | 11/19/1998 | NA | NA | |
| ## | 62003 | 62003 | 12/4/1998 | M | 53 | B4 | CR CR | 1/28/1999 | FALSE | TRUE | |
| ## | 63001 | 63001 | 7/8/1997 | M | 49 | B1 | CR CR | 9/2/1997 | NA | NA | |
| ## | 84004 | 84004 | 9/25/1998 | M | 50 | B | CR CR | 12/1/1998 | NA | NA | |
| ## | 16002 | 16002 | 4/10/1997 | M | 50 | T3 | CR CR | 6/10/1997 | NA | NA | |
| ## | 43015 | 43015 | 2/29/2000 | M | 52 | T2 | CR CR | 6/8/2000 | FALSE | FALSE | |
| ## | cyto.normal | | | | citog | mol.biol | fusion | protein | mdr | kinet | ccr |
| ## | 03002 | NA | | | <NA> | BCR/ABL | | p190 | NEG | dyploid | FALSE |
| ## | 04007 | FALSE | | del(6q) | | NEG | | <NA> | NEG | dyploid | FALSE |
| ## | 08012 | FALSE | | simple alt. | | NEG | | <NA> | NEG | dyploid | FALSE |
| ## | 15004 | FALSE | | t(4;11) | | ALL1/AF4 | | <NA> | NEG | dyploid | FALSE |
| ## | 16004 | FALSE | | t(4;11) | | ALL1/AF4 | | <NA> | NEG | dyploid | FALSE |
| ## | 19005 | TRUE | | normal | | ALL1/AF4 | | <NA> | NEG | dyploid | FALSE |
| ## | 20002 | FALSE | | t(9;22)+other | | BCR/ABL | | p190 | NEG | dyploid | FALSE |
| ## | 24005 | FALSE | | t(4;11) | | ALL1/AF4 | | <NA> | NEG | dyploid | FALSE |
| ## | 24017 | FALSE | | t(9;22)+other | | BCR/ABL | | p190 | NEG | hyperd. | FALSE |
| ## | 26003 | FALSE | | del(p15/p16) | | BCR/ABL | | p210 | NEG | dyploid | FALSE |
| ## | 28028 | FALSE | | t(4;11) | | ALL1/AF4 | | <NA> | NEG | dyploid | FALSE |
| ## | 28036 | FALSE | | t(9;22) | | BCR/ABL | | p190 | NEG | dyploid | FALSE |
| ## | 43001 | FALSE | | t(9;22) | | BCR/ABL | | p190/p210 | POS | dyploid | FALSE |
| ## | 49006 | NA | | <NA> | | BCR/ABL | | p210 | NEG | dyploid | FALSE |
| ## | 62003 | FALSE | | t(9;22)+other | | BCR/ABL | | p210 | NEG | hyperd. | FALSE |
| ## | 63001 | NA | | <NA> | | ALL1/AF4 | | <NA> | NEG | dyploid | FALSE |
| ## | 84004 | NA | | <NA> | | BCR/ABL | | p190 | NEG | dyploid | FALSE |
| ## | 16002 | NA | | <NA> | | NEG | | <NA> | NEG | hyperd. | FALSE |
| ## | 43015 | TRUE | | normal | | NEG | | <NA> | NEG | dyploid | FALSE |
| ## | relapse | transplant | f.u | date | last | seen | | | | | |
| ## | 03002 | TRUE | | FALSE | REL | 10/15/1999 | | | | | |
| ## | 04007 | TRUE | | FALSE | REL | 11/4/1997 | | | | | |
| ## | 08012 | TRUE | | FALSE | REL | 4/9/1999 | | | | | |
| ## | 15004 | TRUE | | FALSE | REL | 12/19/2000 | | | | | |
| ## | 16004 | TRUE | | FALSE | REL | 12/9/1997 | | | | | |

| | | | | | |
|----|-------|------|-------|-----|------------|
| ## | 19005 | TRUE | FALSE | REL | 2/4/1998 |
| ## | 20002 | TRUE | FALSE | REL | 12/15/1997 |
| ## | 24005 | TRUE | FALSE | REL | 8/28/1997 |
| ## | 24017 | TRUE | FALSE | REL | 2/22/2000 |
| ## | 26003 | TRUE | FALSE | REL | 7/1/1998 |
| ## | 28028 | TRUE | FALSE | REL | 10/20/1999 |
| ## | 28036 | TRUE | FALSE | REL | 3/15/1999 |
| ## | 43001 | TRUE | FALSE | REL | 6/28/1998 |
| ## | 49006 | TRUE | FALSE | REL | 4/26/1999 |
| ## | 62003 | TRUE | FALSE | REL | 8/8/2000 |
| ## | 63001 | TRUE | FALSE | REL | 6/10/1998 |
| ## | 84004 | TRUE | FALSE | REL | 1/25/1999 |
| ## | 16002 | TRUE | FALSE | REL | 12/7/1999 |
| ## | 43015 | TRUE | FALSE | REL | 3/15/2002 |

3.3.13 Indexing with

```
df2[df2$age > 40, ]
```

```
# filter rows
```

| ## | cod | diagnosis | sex | age | BT | remission | CR | date.cr |
|----|-------|-----------|------------|------|----|-----------|------|-------------------------|
| ## | 01005 | 1005 | 5/21/1997 | M | 53 | B2 | CR | CR 8/6/1997 |
| ## | 03002 | 3002 | 6/24/1998 | F | 52 | B4 | CR | CR 8/17/1998 |
| ## | 04007 | 4007 | 7/22/1997 | M | 57 | B2 | CR | CR 9/17/1997 |
| ## | 08012 | 8012 | 10/22/1998 | M | 55 | B3 | CR | CR 1/9/1999 |
| ## | 09008 | 9008 | 12/17/1999 | M | 41 | B3 | CR | CR 2/15/2000 |
| ## | 12006 | 12006 | 2/20/1997 | M | 46 | B3 | REF | REF <NA> |
| ## | 12019 | 12019 | 9/4/1997 | M | 53 | B2 | CR | CR 11/11/1997 |
| ## | 14016 | 14016 | 5/27/1999 | M | 53 | B2 | <NA> | <NA> <NA> |
| ## | 15004 | 15004 | 2/10/2000 | M | 44 | B1 | CR | CR 4/3/2000 |
| ## | 16004 | 16004 | 4/19/1997 | F | 58 | B1 | CR | CR 7/15/1997 |
| ## | 16009 | 16009 | 7/11/2000 | F | 43 | B2 | <NA> | <NA> <NA> |
| ## | 19005 | 19005 | 11/15/1997 | F | 48 | B1 | CR | CR 2/3/1998 |
| ## | 20002 | 20002 | 5/9/1997 | F | 58 | B2 | CR | CR 8/19/1997 |
| ## | 24005 | 24005 | 1/3/1997 | F | 45 | B1 | CR | CR 4/8/1997 |
| ## | 24011 | 24011 | 8/5/1997 | F | 51 | B2 | <NA> | DEATH IN INDUCTION <NA> |
| ## | 24017 | 24017 | 9/15/1998 | M | 57 | B2 | CR | CR 12/7/1998 |
| ## | NA | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> <NA> |
| ## | 26003 | 26003 | 2/18/1998 | F | 49 | B4 | CR | CR 4/21/1998 |
| ## | 27004 | 27004 | 10/20/1998 | F | 48 | B2 | REF | REF <NA> |
| ## | 28007 | 28007 | 2/21/1997 | F | 47 | B3 | CR | CR 4/7/1997 |
| ## | 28021 | 28021 | 3/18/1998 | F | 54 | B3 | CR | DEATH IN CR 5/22/1998 |
| ## | 28028 | 28028 | 7/8/1998 | M | 47 | B1 | CR | CR 9/3/1998 |

| | | | | | | | | | | | |
|----|-------|---------|------------|-------------|----|------|------------------|--------------------|------------|-----------|------|
| ## | 28032 | 28032 | 9/26/1998 | F | 52 | B1 | CR | CR | 10/30/1998 | | |
| ## | 28036 | 28036 | 12/23/1998 | M | 52 | B3 | CR | CR | 3/8/1999 | | |
| ## | NA.1 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> | | |
| ## | 30001 | 30001 | 1/16/1997 | F | 54 | B3 | <NA> | DEATH IN INDUCTION | <NA> | | |
| ## | NA.2 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> | | |
| ## | 43001 | 43001 | 11/14/1996 | M | 41 | B1 | CR | CR | 1/30/1997 | | |
| ## | 43007 | 43007 | 10/14/1997 | M | 54 | B4 | CR | CR | 12/30/1997 | | |
| ## | 49006 | 49006 | 8/12/1998 | F | 43 | B2 | CR | CR | 11/19/1998 | | |
| ## | 57001 | 57001 | 1/29/1997 | F | 53 | B3 | <NA> | DEATH IN INDUCTION | <NA> | | |
| ## | 62001 | 62001 | 11/11/1997 | F | 50 | B4 | REF | REF | <NA> | | |
| ## | 62002 | 62002 | 1/15/1998 | M | 54 | B4 | <NA> | DEATH IN INDUCTION | <NA> | | |
| ## | 62003 | 62003 | 12/4/1998 | M | 53 | B4 | CR | CR | 1/28/1999 | | |
| ## | 63001 | 63001 | 7/8/1997 | M | 49 | B1 | CR | CR | 9/2/1997 | | |
| ## | 84004 | 84004 | 9/25/1998 | M | 50 | B | CR | CR | 12/1/1998 | | |
| ## | NA.3 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> | | |
| ## | 02020 | 2020 | 3/23/2000 | F | 48 | T2 | <NA> | DEATH IN INDUCTION | <NA> | | |
| ## | 16002 | 16002 | 4/10/1997 | M | 50 | T3 | CR | CR | 6/10/1997 | | |
| ## | 16007 | 16007 | 11/1/1998 | M | 41 | T3 | CR | CR | 11/5/1998 | | |
| ## | 31015 | 31015 | 12/3/1998 | M | 48 | T2 | <NA> | DEATH IN INDUCTION | <NA> | | |
| ## | 43006 | 43006 | 6/17/1997 | M | 41 | T2 | REF | REF | <NA> | | |
| ## | 43015 | 43015 | 2/29/2000 | M | 52 | T2 | CR | CR | 6/8/2000 | | |
| ## | NA.4 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> | | |
| ## | | t(4;11) | t(9;22) | cyto.normal | | | citog | mol.biol | fusion | protein | mdr |
| ## | 01005 | FALSE | TRUE | FALSE | | | t(9;22) | BCR/ABL | | p210 | NEG |
| ## | 03002 | NA | NA | NA | | | <NA> | BCR/ABL | | p190 | NEG |
| ## | 04007 | FALSE | FALSE | FALSE | | | del(6q) | NEG | | <NA> | NEG |
| ## | 08012 | FALSE | FALSE | FALSE | | | simple alt. | NEG | | <NA> | NEG |
| ## | 09008 | FALSE | TRUE | FALSE | | | t(9;22)+other | BCR/ABL | | p190 | NEG |
| ## | 12006 | FALSE | TRUE | FALSE | | | t(9;22) | BCR/ABL | | p210 | NEG |
| ## | 12019 | FALSE | FALSE | TRUE | | | normal | NEG | | <NA> | POS |
| ## | 14016 | FALSE | TRUE | FALSE | | | t(9;22) | BCR/ABL | | p210 | NEG |
| ## | 15004 | TRUE | FALSE | FALSE | | | t(4;11) | ALL1/AF4 | | <NA> | NEG |
| ## | 16004 | TRUE | FALSE | FALSE | | | t(4;11) | ALL1/AF4 | | <NA> | NEG |
| ## | 16009 | NA | NA | NA | | | <NA> | NEG | | <NA> | POS |
| ## | 19005 | FALSE | FALSE | TRUE | | | normal | ALL1/AF4 | | <NA> | NEG |
| ## | 20002 | FALSE | TRUE | FALSE | | | t(9;22)+other | BCR/ABL | | p190 | NEG |
| ## | 24005 | TRUE | FALSE | FALSE | | | t(4;11) | ALL1/AF4 | | <NA> | NEG |
| ## | 24011 | FALSE | TRUE | FALSE | | | t(9;22) | BCR/ABL | | p210 | POS |
| ## | 24017 | FALSE | TRUE | FALSE | | | t(9;22)+other | BCR/ABL | | p190 | NEG |
| ## | NA | NA | NA | NA | | | <NA> | <NA> | | <NA> | <NA> |
| ## | 26003 | FALSE | FALSE | FALSE | | | del(p15/p16) | BCR/ABL | | p210 | NEG |
| ## | 27004 | FALSE | TRUE | FALSE | | | t(9;22)+del(p15) | BCR/ABL | | p190 | NEG |
| ## | 28007 | FALSE | FALSE | TRUE | | | normal | NEG | | <NA> | NEG |
| ## | 28021 | FALSE | TRUE | FALSE | | | t(9;22)+other | BCR/ABL | | p190/p210 | NEG |
| ## | 28028 | TRUE | FALSE | FALSE | | | t(4;11) | ALL1/AF4 | | <NA> | NEG |
| ## | 28032 | TRUE | FALSE | FALSE | | | t(4;11) | ALL1/AF4 | | <NA> | NEG |

| | | | | | | | |
|----------|---------|-------|---------|---------------|-------------------|-----------|------------|
| ## 28036 | FALSE | TRUE | FALSE | t(9;22) | BCR/ABL | p190 | NEG |
| ## NA.1 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## 30001 | FALSE | TRUE | FALSE | t(9;22)+other | BCR/ABL | p190 | NEG |
| ## NA.2 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## 43001 | FALSE | TRUE | FALSE | t(9;22) | BCR/ABL | p190/p210 | POS |
| ## 43007 | FALSE | FALSE | TRUE | normal | NEG | <NA> | NEG |
| ## 49006 | NA | NA | NA | <NA> | BCR/ABL | p210 | NEG |
| ## 57001 | FALSE | FALSE | TRUE | normal | NEG | <NA> | NEG |
| ## 62001 | FALSE | TRUE | FALSE | t(9;22)+other | BCR/ABL | <NA> | NEG |
| ## 62002 | FALSE | TRUE | FALSE | t(9;22)+other | BCR/ABL | <NA> | NEG |
| ## 62003 | FALSE | TRUE | FALSE | t(9;22)+other | BCR/ABL | p210 | NEG |
| ## 63001 | NA | NA | NA | <NA> | ALL1/AF4 | <NA> | NEG |
| ## 84004 | NA | NA | NA | <NA> | BCR/ABL | p190 | NEG |
| ## NA.3 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## 02020 | FALSE | FALSE | FALSE | complex alt. | NEG | <NA> | NEG |
| ## 16002 | NA | NA | NA | <NA> | NEG | <NA> | NEG |
| ## 16007 | NA | NA | NA | <NA> | NEG | <NA> | NEG |
| ## 31015 | NA | NA | NA | <NA> | NEG | <NA> | POS |
| ## 43006 | FALSE | FALSE | FALSE | simple alt. | NEG | <NA> | POS |
| ## 43015 | FALSE | FALSE | TRUE | normal | NEG | <NA> | NEG |
| ## NA.4 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## | kinet | ccr | relapse | transplant | f.u | date | last seen |
| ## 01005 | dyploid | FALSE | FALSE | TRUE | BMT / DEATH | IN CR | <NA> |
| ## 03002 | dyploid | FALSE | TRUE | FALSE | | REL | 10/15/1999 |
| ## 04007 | dyploid | FALSE | TRUE | FALSE | | REL | 11/4/1997 |
| ## 08012 | dyploid | FALSE | TRUE | FALSE | | REL | 4/9/1999 |
| ## 09008 | hyperd. | TRUE | FALSE | TRUE | BMT / CCR | | 00/09/01 |
| ## 12006 | dyploid | NA | NA | NA | <NA> | | <NA> |
| ## 12019 | dyploid | TRUE | FALSE | FALSE | | CCR | 6/6/2002 |
| ## 14016 | <NA> | NA | NA | NA | <NA> | | <NA> |
| ## 15004 | dyploid | FALSE | TRUE | FALSE | | REL | 12/19/2000 |
| ## 16004 | dyploid | FALSE | TRUE | FALSE | | REL | 12/9/1997 |
| ## 16009 | dyploid | TRUE | FALSE | FALSE | CCR / OFF | | 5/23/2002 |
| ## 19005 | dyploid | FALSE | TRUE | FALSE | | REL | 2/4/1998 |
| ## 20002 | dyploid | FALSE | TRUE | FALSE | | REL | 12/15/1997 |
| ## 24005 | dyploid | FALSE | TRUE | FALSE | | REL | 8/28/1997 |
| ## 24011 | dyploid | NA | NA | NA | <NA> | | <NA> |
| ## 24017 | hyperd. | FALSE | TRUE | FALSE | | REL | 2/22/2000 |
| ## NA | <NA> | NA | NA | NA | <NA> | | <NA> |
| ## 26003 | dyploid | FALSE | TRUE | FALSE | | REL | 7/1/1998 |
| ## 27004 | dyploid | NA | NA | NA | <NA> | | <NA> |
| ## 28007 | dyploid | TRUE | FALSE | FALSE | | CCR | 3/22/2002 |
| ## 28021 | hyperd. | FALSE | FALSE | FALSE | DEATH IN CR (ICR) | | <NA> |
| ## 28028 | dyploid | FALSE | TRUE | FALSE | | REL | 10/20/1999 |
| ## 28032 | dyploid | TRUE | FALSE | FALSE | | CCR | 5/16/2002 |
| ## 28036 | dyploid | FALSE | TRUE | FALSE | | REL | 3/15/1999 |

```
## NA.1      <NA>    NA      NA      NA      <NA>      <NA>
## 30001 hyperd.    NA      NA      NA      <NA>      <NA>
## NA.2      <NA>    NA      NA      NA      <NA>      <NA>
## 43001 dyploid FALSE    TRUE    FALSE    REL      6/28/1998
## 43007 hyperd.    TRUE    FALSE    FALSE    CCR      5/29/2002
## 49006 dyploid FALSE    TRUE    FALSE    REL      4/26/1999
## 57001 hyperd.    NA      NA      NA      <NA>      <NA>
## 62001 hyperd.    NA      NA      NA      <NA>      <NA>
## 62002 hyperd.    NA      NA      NA      <NA>      <NA>
## 62003 hyperd. FALSE    TRUE    FALSE    REL      8/8/2000
## 63001 dyploid FALSE    TRUE    FALSE    REL      6/10/1998
## 84004 dyploid FALSE    TRUE    FALSE    REL      1/25/1999
## NA.3      <NA>    NA      NA      NA      <NA>      <NA>
## 02020 dyploid    NA      NA      NA      <NA>      <NA>
## 16002 hyperd. FALSE    TRUE    FALSE    REL      12/7/1999
## 16007 dyploid    TRUE    FALSE    FALSE    CCR      1/8/2002
## 31015 dyploid    NA      NA      NA      <NA>      <NA>
## 43006 dyploid    NA      NA      NA      <NA>      <NA>
## 43015 dyploid FALSE    TRUE    FALSE    REL      3/15/2002
## NA.4      <NA>    NA      NA      NA      <NA>      <NA>
```

```
df2[df2$age > 40 & df2$relapse, ] # multiple conditions (same as df$Relapse == T)
```

```
##      cod diagnosis sex age  BT remission CR date.cr t(4;11) t(9;22)
## 03002 3002 6/24/1998 F 52  B4      CR CR 8/17/1998    NA      NA
## 04007 4007 7/22/1997 M 57  B2      CR CR 9/17/1997 FALSE FALSE
## 08012 8012 10/22/1998 M 55  B3      CR CR 1/9/1999  FALSE FALSE
## NA      <NA>      <NA> <NA> NA <NA>      <NA> <NA>      <NA>    NA      NA
## NA.1    <NA>      <NA> <NA> NA <NA>      <NA> <NA>      <NA>    NA      NA
## 15004 15004 2/10/2000 M 44  B1      CR CR 4/3/2000    TRUE FALSE
## 16004 16004 4/19/1997 F 58  B1      CR CR 7/15/1997    TRUE FALSE
## 19005 19005 11/15/1997 F 48  B1      CR CR 2/3/1998  FALSE FALSE
## 20002 20002 5/9/1997  F 58  B2      CR CR 8/19/1997  FALSE TRUE
## 24005 24005 1/3/1997  F 45  B1      CR CR 4/8/1997    TRUE FALSE
## NA.2    <NA>      <NA> <NA> NA <NA>      <NA> <NA>      <NA>    NA      NA
## 24017 24017 9/15/1998 M 57  B2      CR CR 12/7/1998  FALSE TRUE
## 26003 26003 2/18/1998 F 49  B4      CR CR 4/21/1998  FALSE FALSE
## NA.3    <NA>      <NA> <NA> NA <NA>      <NA> <NA>      <NA>    NA      NA
## 28028 28028 7/8/1998  M 47  B1      CR CR 9/3/1998    TRUE FALSE
## 28036 28036 12/23/1998 M 52  B3      CR CR 3/8/1999  FALSE TRUE
## NA.4    <NA>      <NA> <NA> NA <NA>      <NA> <NA>      <NA>    NA      NA
## NA.5    <NA>      <NA> <NA> NA <NA>      <NA> <NA>      <NA>    NA      NA
## NA.6    <NA>      <NA> <NA> NA <NA>      <NA> <NA>      <NA>    NA      NA
## 43001 43001 11/14/1996 M 41  B1      CR CR 1/30/1997  FALSE TRUE
```

| | | | | | | | | | | | |
|----|-------|-------------|-----------|---------------|----------|----------|--------|-----------|------------|---------|-------|
| ## | 49006 | 49006 | 8/12/1998 | F | 43 | B2 | CR | CR | 11/19/1998 | NA | NA |
| ## | NA.7 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> | NA | NA |
| ## | NA.8 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> | NA | NA |
| ## | NA.9 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> | NA | NA |
| ## | 62003 | 62003 | 12/4/1998 | M | 53 | B4 | CR | CR | 1/28/1999 | FALSE | TRUE |
| ## | 63001 | 63001 | 7/8/1997 | M | 49 | B1 | CR | CR | 9/2/1997 | NA | NA |
| ## | 84004 | 84004 | 9/25/1998 | M | 50 | B | CR | CR | 12/1/1998 | NA | NA |
| ## | NA.10 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> | NA | NA |
| ## | NA.11 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> | NA | NA |
| ## | 16002 | 16002 | 4/10/1997 | M | 50 | T3 | CR | CR | 6/10/1997 | NA | NA |
| ## | NA.12 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> | NA | NA |
| ## | NA.13 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> | NA | NA |
| ## | 43015 | 43015 | 2/29/2000 | M | 52 | T2 | CR | CR | 6/8/2000 | FALSE | FALSE |
| ## | NA.14 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> | NA | NA |
| ## | | cyto.normal | | | citog | mol.biol | fusion | protein | mdr | kinet | ccr |
| ## | 03002 | NA | | <NA> | BCR/ABL | | | p190 | NEG | dyploid | FALSE |
| ## | 04007 | FALSE | | del(6q) | NEG | | | <NA> | NEG | dyploid | FALSE |
| ## | 08012 | FALSE | | simple alt. | NEG | | | <NA> | NEG | dyploid | FALSE |
| ## | NA | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |
| ## | NA.1 | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |
| ## | 15004 | FALSE | | t(4;11) | ALL1/AF4 | | | <NA> | NEG | dyploid | FALSE |
| ## | 16004 | FALSE | | t(4;11) | ALL1/AF4 | | | <NA> | NEG | dyploid | FALSE |
| ## | 19005 | TRUE | | normal | ALL1/AF4 | | | <NA> | NEG | dyploid | FALSE |
| ## | 20002 | FALSE | | t(9;22)+other | BCR/ABL | | | p190 | NEG | dyploid | FALSE |
| ## | 24005 | FALSE | | t(4;11) | ALL1/AF4 | | | <NA> | NEG | dyploid | FALSE |
| ## | NA.2 | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |
| ## | 24017 | FALSE | | t(9;22)+other | BCR/ABL | | | p190 | NEG | hyperd. | FALSE |
| ## | 26003 | FALSE | | del(p15/p16) | BCR/ABL | | | p210 | NEG | dyploid | FALSE |
| ## | NA.3 | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |
| ## | 28028 | FALSE | | t(4;11) | ALL1/AF4 | | | <NA> | NEG | dyploid | FALSE |
| ## | 28036 | FALSE | | t(9;22) | BCR/ABL | | | p190 | NEG | dyploid | FALSE |
| ## | NA.4 | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |
| ## | NA.5 | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |
| ## | NA.6 | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |
| ## | 43001 | FALSE | | t(9;22) | BCR/ABL | | | p190/p210 | POS | dyploid | FALSE |
| ## | 49006 | NA | | <NA> | BCR/ABL | | | p210 | NEG | dyploid | FALSE |
| ## | NA.7 | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |
| ## | NA.8 | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |
| ## | NA.9 | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |
| ## | 62003 | FALSE | | t(9;22)+other | BCR/ABL | | | p210 | NEG | hyperd. | FALSE |
| ## | 63001 | NA | | <NA> | ALL1/AF4 | | | <NA> | NEG | dyploid | FALSE |
| ## | 84004 | NA | | <NA> | BCR/ABL | | | p190 | NEG | dyploid | FALSE |
| ## | NA.10 | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |
| ## | NA.11 | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |
| ## | 16002 | NA | | <NA> | NEG | | | <NA> | NEG | hyperd. | FALSE |
| ## | NA.12 | NA | | <NA> | <NA> | | | <NA> | <NA> | <NA> | NA |


```
## NA.13      NA      <NA>      <NA>      <NA> <NA>      <NA>      NA
## 43015      TRUE      normal      NEG      <NA>      NEG dyploid FALSE
## NA.14      NA      <NA>      <NA>      <NA> <NA>      <NA>      NA
##      relapse transplant f.u date last seen
## 03002      TRUE      FALSE REL      10/15/1999
## 04007      TRUE      FALSE REL      11/4/1997
## 08012      TRUE      FALSE REL      4/9/1999
## NA      NA      NA <NA>      <NA>
## NA.1      NA      NA <NA>      <NA>
## 15004      TRUE      FALSE REL      12/19/2000
## 16004      TRUE      FALSE REL      12/9/1997
## 19005      TRUE      FALSE REL      2/4/1998
## 20002      TRUE      FALSE REL      12/15/1997
## 24005      TRUE      FALSE REL      8/28/1997
## NA.2      NA      NA <NA>      <NA>
## 24017      TRUE      FALSE REL      2/22/2000
## 26003      TRUE      FALSE REL      7/1/1998
## NA.3      NA      NA <NA>      <NA>
## 28028      TRUE      FALSE REL      10/20/1999
## 28036      TRUE      FALSE REL      3/15/1999
## NA.4      NA      NA <NA>      <NA>
## NA.5      NA      NA <NA>      <NA>
## NA.6      NA      NA <NA>      <NA>
## 43001      TRUE      FALSE REL      6/28/1998
## 49006      TRUE      FALSE REL      4/26/1999
## NA.7      NA      NA <NA>      <NA>
## NA.8      NA      NA <NA>      <NA>
## NA.9      NA      NA <NA>      <NA>
## 62003      TRUE      FALSE REL      8/8/2000
## 63001      TRUE      FALSE REL      6/10/1998
## 84004      TRUE      FALSE REL      1/25/1999
## NA.10      NA      NA <NA>      <NA>
## NA.11      NA      NA <NA>      <NA>
## 16002      TRUE      FALSE REL      12/7/1999
## NA.12      NA      NA <NA>      <NA>
## NA.13      NA      NA <NA>      <NA>
## 43015      TRUE      FALSE REL      3/15/2002
## NA.14      NA      NA <NA>      <NA>
```

```
df2[, c("age", "BT")] # select columns
```

```
##      age BT
## 01005  53 B2
## 01010  19 B2
```

| | | | |
|----|-------|----|----|
| ## | 03002 | 52 | B4 |
| ## | 04006 | 38 | B1 |
| ## | 04007 | 57 | B2 |
| ## | 04008 | 17 | B1 |
| ## | 04010 | 18 | B1 |
| ## | 04016 | 16 | B1 |
| ## | 06002 | 15 | B2 |
| ## | 08001 | 40 | B2 |
| ## | 08011 | 33 | B3 |
| ## | 08012 | 55 | B3 |
| ## | 08018 | 5 | B3 |
| ## | 08024 | 18 | B2 |
| ## | 09008 | 41 | B3 |
| ## | 09017 | 27 | B |
| ## | 11005 | 27 | B2 |
| ## | 12006 | 46 | B3 |
| ## | 12007 | 37 | B2 |
| ## | 12012 | 36 | B3 |
| ## | 12019 | 53 | B2 |
| ## | 12026 | 39 | B2 |
| ## | 14016 | 53 | B2 |
| ## | 15001 | 20 | B1 |
| ## | 15004 | 44 | B1 |
| ## | 15005 | 28 | B2 |
| ## | 16004 | 58 | B1 |
| ## | 16009 | 43 | B2 |
| ## | 19005 | 48 | B1 |
| ## | 20002 | 58 | B2 |
| ## | 22009 | 19 | B |
| ## | 22010 | 26 | B |
| ## | 22011 | 19 | B2 |
| ## | 22013 | 32 | B2 |
| ## | 24001 | 17 | B2 |
| ## | 24005 | 45 | B1 |
| ## | 24008 | 20 | B2 |
| ## | 24010 | 16 | B2 |
| ## | 24011 | 51 | B2 |
| ## | 24017 | 57 | B2 |
| ## | 24018 | 29 | B2 |
| ## | 24019 | 16 | B4 |
| ## | 24022 | 32 | B4 |
| ## | 25003 | 15 | B2 |
| ## | 25006 | NA | B2 |
| ## | 26001 | 21 | B2 |
| ## | 26003 | 49 | B4 |
| ## | 26005 | 38 | B2 |

```
## 26008 17 B1
## 27003 26 B2
## 27004 48 B2
## 28001 16 B3
## 28003 18 B4
## 28005 17 B3
## 28006 22 B3
## 28007 47 B3
## 28019 21 B4
## 28021 54 B3
## 28023 26 B3
## 28024 19 B1
## 28028 47 B1
## 28031 18 B1
## 28032 52 B1
## 28035 27 B3
## 28036 52 B3
## 28037 18 B3
## 28042 18 B3
## 28043 23 B3
## 28044 16 B3
## 28047 NA B3
## 30001 54 B3
## 31007 25 B1
## 31011 31 B3
## 33005 19 B1
## 36001 24 B4
## 36002 23 B2
## 37013 NA B2
## 43001 41 B1
## 43004 37 B3
## 43007 54 B4
## 43012 18 B4
## 48001 19 B2
## 49006 43 B2
## 57001 53 B3
## 62001 50 B4
## 62002 54 B4
## 62003 53 B4
## 63001 49 B1
## 64001 20 B2
## 64002 26 B2
## 65005 22 B2
## 68001 36 B1
## 68003 27 B2
## 84004 50 B
```

```
## LAL5    NA  B
## 01003   31  T
## 01007   16 T3
## 02020   48 T2
## 04018   17 T2
## 09002   40 T3
## 10005   22 T2
## 11002   30  T
## 12008   18 T4
## 15006   22 T2
## 16002   50 T3
## 16007   41 T3
## 17003   40  T
## 18001   28 T2
## 19002   25 T3
## 19008   16 T2
## 19014   31 T2
## 19017   14 T2
## 20005   24 T1
## 24006   19 T4
## 26009   37  T
## 28008   23 T2
## 28009   30 T3
## 31015   48 T2
## 37001   22 T2
## 43006   41 T2
## 43015   52 T2
## 44001   32 T3
## 49004   24 T3
## 56007   37 T3
## 64005   19 T2
## 65003   30 T3
## 83001   29 T2
## LAL4    NA  T
```

```
df <- df2[df2$sex == "F", ] # female patients only (#Assignment with condition)
```

3.3.14 with()

```
df2 <- with(df2, df2[age > 40 & relapse == TRUE, ]) #for cleaner syntax
df2[which(df2$age > 40 & df2$relapse == TRUE), ] # more cleanr syntax
```

| ## | cod | diagnosis | sex | age | BT | remission | CR | date.cr | t(4;11) | t(9;22) | |
|----|-------------|------------|------------|---------------|-------|------------|--------|------------|---------|---------|-------|
| ## | 03002 | 3002 | 6/24/1998 | F | 52 | B4 | CR CR | 8/17/1998 | NA | NA | |
| ## | 04007 | 4007 | 7/22/1997 | M | 57 | B2 | CR CR | 9/17/1997 | FALSE | FALSE | |
| ## | 08012 | 8012 | 10/22/1998 | M | 55 | B3 | CR CR | 1/9/1999 | FALSE | FALSE | |
| ## | 15004 | 15004 | 2/10/2000 | M | 44 | B1 | CR CR | 4/3/2000 | TRUE | FALSE | |
| ## | 16004 | 16004 | 4/19/1997 | F | 58 | B1 | CR CR | 7/15/1997 | TRUE | FALSE | |
| ## | 19005 | 19005 | 11/15/1997 | F | 48 | B1 | CR CR | 2/3/1998 | FALSE | FALSE | |
| ## | 20002 | 20002 | 5/9/1997 | F | 58 | B2 | CR CR | 8/19/1997 | FALSE | TRUE | |
| ## | 24005 | 24005 | 1/3/1997 | F | 45 | B1 | CR CR | 4/8/1997 | TRUE | FALSE | |
| ## | 24017 | 24017 | 9/15/1998 | M | 57 | B2 | CR CR | 12/7/1998 | FALSE | TRUE | |
| ## | 26003 | 26003 | 2/18/1998 | F | 49 | B4 | CR CR | 4/21/1998 | FALSE | FALSE | |
| ## | 28028 | 28028 | 7/8/1998 | M | 47 | B1 | CR CR | 9/3/1998 | TRUE | FALSE | |
| ## | 28036 | 28036 | 12/23/1998 | M | 52 | B3 | CR CR | 3/8/1999 | FALSE | TRUE | |
| ## | 43001 | 43001 | 11/14/1996 | M | 41 | B1 | CR CR | 1/30/1997 | FALSE | TRUE | |
| ## | 49006 | 49006 | 8/12/1998 | F | 43 | B2 | CR CR | 11/19/1998 | NA | NA | |
| ## | 62003 | 62003 | 12/4/1998 | M | 53 | B4 | CR CR | 1/28/1999 | FALSE | TRUE | |
| ## | 63001 | 63001 | 7/8/1997 | M | 49 | B1 | CR CR | 9/2/1997 | NA | NA | |
| ## | 84004 | 84004 | 9/25/1998 | M | 50 | B | CR CR | 12/1/1998 | NA | NA | |
| ## | 16002 | 16002 | 4/10/1997 | M | 50 | T3 | CR CR | 6/10/1997 | NA | NA | |
| ## | 43015 | 43015 | 2/29/2000 | M | 52 | T2 | CR CR | 6/8/2000 | FALSE | FALSE | |
| ## | cyto.normal | | | | citog | mol.biol | fusion | protein | mdr | kinet | ccr |
| ## | 03002 | NA | | | <NA> | BCR/ABL | | p190 | NEG | dyploid | FALSE |
| ## | 04007 | FALSE | | del(6q) | | NEG | | <NA> | NEG | dyploid | FALSE |
| ## | 08012 | FALSE | | simple alt. | | NEG | | <NA> | NEG | dyploid | FALSE |
| ## | 15004 | FALSE | | t(4;11) | | ALL1/AF4 | | <NA> | NEG | dyploid | FALSE |
| ## | 16004 | FALSE | | t(4;11) | | ALL1/AF4 | | <NA> | NEG | dyploid | FALSE |
| ## | 19005 | TRUE | | normal | | ALL1/AF4 | | <NA> | NEG | dyploid | FALSE |
| ## | 20002 | FALSE | | t(9;22)+other | | BCR/ABL | | p190 | NEG | dyploid | FALSE |
| ## | 24005 | FALSE | | t(4;11) | | ALL1/AF4 | | <NA> | NEG | dyploid | FALSE |
| ## | 24017 | FALSE | | t(9;22)+other | | BCR/ABL | | p190 | NEG | hyperd. | FALSE |
| ## | 26003 | FALSE | | del(p15/p16) | | BCR/ABL | | p210 | NEG | dyploid | FALSE |
| ## | 28028 | FALSE | | t(4;11) | | ALL1/AF4 | | <NA> | NEG | dyploid | FALSE |
| ## | 28036 | FALSE | | t(9;22) | | BCR/ABL | | p190 | NEG | dyploid | FALSE |
| ## | 43001 | FALSE | | t(9;22) | | BCR/ABL | | p190/p210 | POS | dyploid | FALSE |
| ## | 49006 | NA | | <NA> | | BCR/ABL | | p210 | NEG | dyploid | FALSE |
| ## | 62003 | FALSE | | t(9;22)+other | | BCR/ABL | | p210 | NEG | hyperd. | FALSE |
| ## | 63001 | NA | | <NA> | | ALL1/AF4 | | <NA> | NEG | dyploid | FALSE |
| ## | 84004 | NA | | <NA> | | BCR/ABL | | p190 | NEG | dyploid | FALSE |
| ## | 16002 | NA | | <NA> | | NEG | | <NA> | NEG | hyperd. | FALSE |
| ## | 43015 | TRUE | | normal | | NEG | | <NA> | NEG | dyploid | FALSE |
| ## | relapse | transplant | f.u | date | last | seen | | | | | |
| ## | 03002 | TRUE | | FALSE | REL | 10/15/1999 | | | | | |
| ## | 04007 | TRUE | | FALSE | REL | 11/4/1997 | | | | | |
| ## | 08012 | TRUE | | FALSE | REL | 4/9/1999 | | | | | |
| ## | 15004 | TRUE | | FALSE | REL | 12/19/2000 | | | | | |
| ## | 16004 | TRUE | | FALSE | REL | 12/9/1997 | | | | | |

```
## 19005    TRUE    FALSE REL      2/4/1998
## 20002    TRUE    FALSE REL     12/15/1997
## 24005    TRUE    FALSE REL      8/28/1997
## 24017    TRUE    FALSE REL     2/22/2000
## 26003    TRUE    FALSE REL      7/1/1998
## 28028    TRUE    FALSE REL     10/20/1999
## 28036    TRUE    FALSE REL      3/15/1999
## 43001    TRUE    FALSE REL      6/28/1998
## 49006    TRUE    FALSE REL      4/26/1999
## 62003    TRUE    FALSE REL      8/8/2000
## 63001    TRUE    FALSE REL      6/10/1998
## 84004    TRUE    FALSE REL      1/25/1999
## 16002    TRUE    FALSE REL      12/7/1999
## 43015    TRUE    FALSE REL      3/15/2002
```

3.3.15 match() / %in% (matching values)

```
dfrt <- df2[df2$BT %in% c("B2", "B3"), ]
```

3.3.16 Logical indexing directly

```
df2[df2$relapse == F | df2$sex == "F", ]
```

| ## | cod | diagnosis | sex | age | BT | remission | CR | date.cr |
|----------|-------|------------|------|-----|------|-----------|-------------|------------|
| ## 01005 | 1005 | 5/21/1997 | M | 53 | B2 | CR | CR | 8/6/1997 |
| ## 03002 | 3002 | 6/24/1998 | F | 52 | B4 | CR | CR | 8/17/1998 |
| ## 04010 | 4010 | 10/30/1997 | F | 18 | B1 | CR | CR | 1/7/1998 |
| ## 08011 | 8011 | 8/21/1998 | M | 33 | B3 | CR | CR | 10/8/1998 |
| ## NA | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> |
| ## 09008 | 9008 | 12/17/1999 | M | 41 | B3 | CR | CR | 2/15/2000 |
| ## 09017 | 9017 | 2/3/2000 | F | 27 | B | CR | CR | 3/23/2000 |
| ## 11005 | 11005 | 6/1/1998 | M | 27 | B2 | CR | DEATH IN CR | 8/3/1998 |
| ## NA.1 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> |
| ## 12012 | 12012 | 5/21/1997 | F | 36 | B3 | REF | REF | <NA> |
| ## 12019 | 12019 | 9/4/1997 | M | 53 | B2 | CR | CR | 11/11/1997 |
| ## 12026 | 12026 | 5/29/1998 | M | 39 | B2 | REF | REF | <NA> |
| ## NA.2 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> |
| ## 15001 | 15001 | 9/3/1997 | M | 20 | B1 | CR | CR | 11/11/1997 |
| ## 16004 | 16004 | 4/19/1997 | F | 58 | B1 | CR | CR | 7/15/1997 |

3.3. LAB 1B

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| | | | | | | | | | |
|----|-------|-------|------------|------|----|------|------|--------------------|--------------|
| ## | 16009 | 16009 | 7/11/2000 | F | 43 | B2 | <NA> | <NA> | <NA> |
| ## | 19005 | 19005 | 11/15/1997 | F | 48 | B1 | CR | CR | 2/3/1998 |
| ## | 20002 | 20002 | 5/9/1997 | F | 58 | B2 | CR | CR | 8/19/1997 |
| ## | 22009 | 22009 | 8/10/1999 | F | 19 | B | <NA> | <NA> | <NA> |
| ## | 22010 | 22010 | 12/31/1999 | F | 26 | B | <NA> | <NA> | <NA> |
| ## | 22011 | 22011 | 4/7/2000 | M | 19 | B2 | CR | CR | 5/19/2000 |
| ## | NA.3 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> |
| ## | 24001 | 24001 | 10/4/1996 | F | 17 | B2 | CR | CR | 12/20/1996 |
| ## | 24005 | 24005 | 1/3/1997 | F | 45 | B1 | CR | CR | 4/8/1997 |
| ## | 24008 | 24008 | 5/14/1997 | F | 20 | B2 | CR | CR | 7/31/1997 |
| ## | 24010 | 24010 | 6/3/1997 | F | 16 | B2 | CR | CR | 8/11/1997 |
| ## | 24011 | 24011 | 8/5/1997 | F | 51 | B2 | <NA> | DEATH IN INDUCTION | <NA> |
| ## | 24018 | 24018 | 2/18/1999 | F | 29 | B2 | CR | CR | 5/4/1999 |
| ## | 24022 | 24022 | 12/21/1999 | F | 32 | B4 | REF | REF | <NA> |
| ## | 25003 | 25003 | 5/22/1998 | M | 15 | B2 | CR | CR | 8/4/1998 |
| ## | 25006 | 25006 | 3/18/2000 | <NA> | NA | B2 | CR | CR | 5/8/2000 |
| ## | 26001 | 26001 | 9/27/1997 | M | 21 | B2 | CR | CR | 12/11/1997 |
| ## | 26003 | 26003 | 2/18/1998 | F | 49 | B4 | CR | CR | 4/21/1998 |
| ## | 26008 | 26008 | 8/25/1999 | F | 17 | B1 | CR | CR | 10/14/1999 |
| ## | 27003 | 27003 | 1/17/1998 | F | 26 | B2 | CR | CR | 3/16/1998 |
| ## | 27004 | 27004 | 10/20/1998 | F | 48 | B2 | REF | REF | <NA> |
| ## | NA.4 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> |
| ## | 28003 | 28003 | 11/28/1996 | M | 18 | B4 | CR | CR | 1/17/1997 |
| ## | 28007 | 28007 | 2/21/1997 | F | 47 | B3 | CR | CR | 4/7/1997 |
| ## | 28019 | 28019 | 2/10/1998 | M | 21 | B4 | CR | CR | 4/2/1998 |
| ## | 28021 | 28021 | 3/18/1998 | F | 54 | B3 | CR | DEATH IN | CR 5/22/1998 |
| ## | 28024 | 28024 | 4/19/1998 | F | 19 | B1 | CR | CR | 6/17/1998 |
| ## | 28032 | 28032 | 9/26/1998 | F | 52 | B1 | CR | CR | 10/30/1998 |
| ## | 28035 | 28035 | 12/21/1998 | M | 27 | B3 | CR | CR | 2/12/1999 |
| ## | 30001 | 30001 | 1/16/1997 | F | 54 | B3 | <NA> | DEATH IN INDUCTION | <NA> |
| ## | 33005 | 33005 | 2/10/1998 | F | 19 | B1 | CR | CR | 4/29/1998 |
| ## | 36001 | 36001 | 9/29/1997 | F | 24 | B4 | CR | CR | 12/5/1997 |
| ## | NA.5 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> |
| ## | 43004 | 43004 | 2/4/1997 | F | 37 | B3 | CR | CR | 4/1/1997 |
| ## | 43007 | 43007 | 10/14/1997 | M | 54 | B4 | CR | CR | 12/30/1997 |
| ## | 48001 | 48001 | 3/22/1997 | M | 19 | B2 | CR | CR | 5/20/1997 |
| ## | 49006 | 49006 | 8/12/1998 | F | 43 | B2 | CR | CR | 11/19/1998 |
| ## | 57001 | 57001 | 1/29/1997 | F | 53 | B3 | <NA> | DEATH IN INDUCTION | <NA> |
| ## | 62001 | 62001 | 11/11/1997 | F | 50 | B4 | REF | REF | <NA> |
| ## | NA.6 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> |
| ## | 64002 | 64002 | 10/21/1997 | F | 26 | B2 | CR | CR | 1/21/1998 |
| ## | NA.7 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> |
| ## | 68001 | 68001 | 5/15/1997 | M | 36 | B1 | CR | CR | 7/22/1997 |
| ## | 68003 | 68003 | 4/11/2000 | F | 27 | B2 | <NA> | DEATH IN INDUCTION | <NA> |
| ## | NA.8 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | <NA> | <NA> |
| ## | 01007 | 1007 | 9/30/1998 | F | 16 | T3 | CR | CR | 11/30/1998 |

| | | | | | | | | | | | |
|----|-------|---------|------------|-------------|----|-----------------|----------|--------------------|--------|------------|------|
| ## | 02020 | 2020 | 3/23/2000 | F | 48 | T2 | <NA> | DEATH IN INDUCTION | <NA> | | |
| ## | 04018 | 4018 | 3/24/2000 | M | 17 | T2 | CR | | CR | 5/23/2000 | |
| ## | 09002 | 9002 | 5/14/1998 | F | 40 | T3 | CR | | CR | 7/21/1998 | |
| ## | NA.9 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | | <NA> | <NA> | |
| ## | 16007 | 16007 | 11/1/1998 | M | 41 | T3 | CR | | CR | 11/5/1998 | |
| ## | 17003 | 17003 | 4/8/1997 | F | 40 | T | REF | | REF | <NA> | |
| ## | 18001 | 18001 | 4/23/1997 | F | 28 | T2 | REF | | REF | <NA> | |
| ## | 19008 | 19008 | 4/29/1998 | F | 16 | T2 | REF | | REF | <NA> | |
| ## | 20005 | 20005 | 3/15/2000 | M | 24 | T1 | CR | | CR | 5/5/2000 | |
| ## | 24006 | 24006 | 1/14/1997 | F | 19 | T4 | CR | | CR | not known | |
| ## | 28008 | 28008 | 3/27/1997 | M | 23 | T2 | CR | | CR | 5/27/1997 | |
| ## | 28009 | 28009 | 4/19/1997 | F | 30 | T3 | CR | | CR | 6/13/1997 | |
| ## | NA.10 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | | <NA> | <NA> | |
| ## | NA.11 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | | <NA> | <NA> | |
| ## | 49004 | 49004 | 9/18/1997 | M | 24 | T3 | CR | | CR | 11/11/1997 | |
| ## | 56007 | 56007 | 8/6/1999 | M | 37 | T3 | CR | | CR | 9/24/1999 | |
| ## | NA.12 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | | <NA> | <NA> | |
| ## | 83001 | 83001 | 10/23/1998 | M | 29 | T2 | CR | | CR | 12/21/1998 | |
| ## | NA.13 | <NA> | <NA> | <NA> | NA | <NA> | <NA> | | <NA> | <NA> | |
| ## | | t(4;11) | t(9;22) | cyto.normal | | | citog | mol.biol | fusion | protein | mdr |
| ## | 01005 | FALSE | TRUE | FALSE | | | t(9;22) | BCR/ABL | | p210 | NEG |
| ## | 03002 | NA | NA | NA | | | <NA> | BCR/ABL | | p190 | NEG |
| ## | 04010 | FALSE | FALSE | FALSE | | complex alt. | | NEG | | <NA> | POS |
| ## | 08011 | FALSE | FALSE | FALSE | | del(p15/p16) | BCR/ABL | | | p190/p210 | NEG |
| ## | NA | NA | NA | NA | | | <NA> | <NA> | | <NA> | <NA> |
| ## | 09008 | FALSE | TRUE | FALSE | | t(9;22)+other | BCR/ABL | | | p190 | NEG |
| ## | 09017 | FALSE | FALSE | TRUE | | normal | | NEG | | <NA> | NEG |
| ## | 11005 | FALSE | FALSE | FALSE | | del(7q) + altro | BCR/ABL | | | p190 | NEG |
| ## | NA.1 | NA | NA | NA | | | <NA> | <NA> | | <NA> | <NA> |
| ## | 12012 | FALSE | TRUE | FALSE | | t(9;22) | BCR/ABL | | | p190 | NEG |
| ## | 12019 | FALSE | FALSE | TRUE | | normal | | NEG | | <NA> | POS |
| ## | 12026 | FALSE | TRUE | FALSE | | t(9;22) | BCR/ABL | | | p190/p210 | <NA> |
| ## | NA.2 | NA | NA | NA | | | <NA> | <NA> | | <NA> | <NA> |
| ## | 15001 | FALSE | FALSE | TRUE | | normal | | NEG | | <NA> | NEG |
| ## | 16004 | TRUE | FALSE | FALSE | | t(4;11) | ALL1/AF4 | | | <NA> | NEG |
| ## | 16009 | NA | NA | NA | | | <NA> | NEG | | <NA> | POS |
| ## | 19005 | FALSE | FALSE | TRUE | | normal | ALL1/AF4 | | | <NA> | NEG |
| ## | 20002 | FALSE | TRUE | FALSE | | t(9;22)+other | BCR/ABL | | | p190 | NEG |
| ## | 22009 | FALSE | FALSE | FALSE | | simple alt. | | NEG | | <NA> | NEG |
| ## | 22010 | FALSE | TRUE | FALSE | | t(9;22) | BCR/ABL | | | p190/p210 | NEG |
| ## | 22011 | FALSE | FALSE | TRUE | | normal | | NEG | | <NA> | NEG |
| ## | NA.3 | NA | NA | NA | | | <NA> | <NA> | | <NA> | <NA> |
| ## | 24001 | NA | NA | NA | | | <NA> | BCR/ABL | | p190 | NEG |
| ## | 24005 | TRUE | FALSE | FALSE | | t(4;11) | ALL1/AF4 | | | <NA> | NEG |
| ## | 24008 | NA | NA | NA | | | <NA> | NEG | | <NA> | NEG |
| ## | 24010 | FALSE | TRUE | FALSE | | t(9;22) | BCR/ABL | | | p190/p210 | NEG |

| | | | | | | | |
|----------|-------|-------|-------|------------------|----------|-----------|------|
| ## 24011 | FALSE | TRUE | FALSE | t(9;22) | BCR/ABL | p210 | POS |
| ## 24018 | NA | NA | NA | <NA> | NEG | <NA> | POS |
| ## 24022 | FALSE | TRUE | FALSE | t(9;22) | BCR/ABL | p190 | POS |
| ## 25003 | FALSE | FALSE | FALSE | simple alt. | NEG | <NA> | POS |
| ## 25006 | NA | NA | NA | <NA> | NEG | <NA> | NEG |
| ## 26001 | NA | NA | NA | <NA> | NEG | <NA> | POS |
| ## 26003 | FALSE | FALSE | FALSE | del(p15/p16) | BCR/ABL | p210 | NEG |
| ## 26008 | FALSE | FALSE | TRUE | normal | ALL1/AF4 | <NA> | NEG |
| ## 27003 | NA | NA | NA | <NA> | BCR/ABL | p190/p210 | POS |
| ## 27004 | FALSE | TRUE | FALSE | t(9;22)+del(p15) | BCR/ABL | p190 | NEG |
| ## NA.4 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## 28003 | NA | NA | NA | <NA> | E2A/PBX1 | <NA> | NEG |
| ## 28007 | FALSE | FALSE | TRUE | normal | NEG | <NA> | NEG |
| ## 28019 | NA | NA | NA | <NA> | BCR/ABL | p190 | NEG |
| ## 28021 | FALSE | TRUE | FALSE | t(9;22)+other | BCR/ABL | p190/p210 | NEG |
| ## 28024 | FALSE | FALSE | FALSE | complex alt. | NEG | <NA> | NEG |
| ## 28032 | TRUE | FALSE | FALSE | t(4;11) | ALL1/AF4 | <NA> | NEG |
| ## 28035 | NA | NA | NA | <NA> | NEG | <NA> | POS |
| ## 30001 | FALSE | TRUE | FALSE | t(9;22)+other | BCR/ABL | p190 | NEG |
| ## 33005 | FALSE | FALSE | FALSE | complex alt. | NEG | <NA> | NEG |
| ## 36001 | FALSE | FALSE | TRUE | normal | E2A/PBX1 | <NA> | NEG |
| ## NA.5 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## 43004 | NA | NA | NA | <NA> | NEG | <NA> | NEG |
| ## 43007 | FALSE | FALSE | TRUE | normal | NEG | <NA> | NEG |
| ## 48001 | FALSE | FALSE | FALSE | complex alt. | NEG | <NA> | NEG |
| ## 49006 | NA | NA | NA | <NA> | BCR/ABL | p210 | NEG |
| ## 57001 | FALSE | FALSE | TRUE | normal | NEG | <NA> | NEG |
| ## 62001 | FALSE | TRUE | FALSE | t(9;22)+other | BCR/ABL | <NA> | NEG |
| ## NA.6 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## 64002 | NA | NA | NA | <NA> | NEG | <NA> | NEG |
| ## NA.7 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## 68001 | FALSE | FALSE | TRUE | normal | NEG | <NA> | NEG |
| ## 68003 | FALSE | TRUE | FALSE | t(9;22)+other | BCR/ABL | p190 | NEG |
| ## NA.8 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## 01007 | FALSE | FALSE | FALSE | simple alt. | NUP-98 | <NA> | NEG |
| ## 02020 | FALSE | FALSE | FALSE | complex alt. | NEG | <NA> | NEG |
| ## 04018 | FALSE | FALSE | FALSE | simple alt. | NEG | <NA> | NEG |
| ## 09002 | NA | NA | NA | <NA> | NEG | <NA> | NEG |
| ## NA.9 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## 16007 | NA | NA | NA | <NA> | NEG | <NA> | NEG |
| ## 17003 | NA | NA | NA | <NA> | NEG | <NA> | POS |
| ## 18001 | NA | NA | NA | <NA> | NEG | <NA> | NEG |
| ## 19008 | FALSE | FALSE | TRUE | normal | NEG | <NA> | POS |
| ## 20005 | NA | NA | NA | <NA> | NEG | <NA> | NEG |
| ## 24006 | FALSE | FALSE | FALSE | simple alt. | NEG | <NA> | NEG |
| ## 28008 | FALSE | FALSE | TRUE | normal | NEG | <NA> | NEG |

| | | | | | | | |
|----------|---------|-------|---------|--------------|-------------|-----------------|-----------|
| ## 28009 | NA | NA | NA | <NA> | NEG | <NA> | NEG |
| ## NA.10 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## NA.11 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## 49004 | FALSE | FALSE | FALSE | del(7q) | NEG | <NA> | POS |
| ## 56007 | NA | NA | NA | <NA> | NEG | <NA> | NEG |
| ## NA.12 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## 83001 | FALSE | FALSE | FALSE | complex alt. | NEG | <NA> | NEG |
| ## NA.13 | NA | NA | NA | <NA> | <NA> | <NA> | <NA> |
| ## | kinet | ccr | relapse | transplant | f.u | date | last seen |
| ## 01005 | dyploid | FALSE | FALSE | TRUE BMT / | DEATH IN CR | | <NA> |
| ## 03002 | dyploid | FALSE | TRUE | FALSE | REL | 10/15/1999 | |
| ## 04010 | hyperd. | FALSE | TRUE | FALSE | REL | 3/5/1998 | |
| ## 08011 | dyploid | FALSE | FALSE | TRUE BMT / | DEATH IN CR | | <NA> |
| ## NA | <NA> | NA | NA | NA | <NA> | | <NA> |
| ## 09008 | hyperd. | TRUE | FALSE | TRUE | BMT / CCR | 00/09/01 | |
| ## 09017 | dyploid | FALSE | TRUE | FALSE | REL | 9/11/2001 | |
| ## 11005 | dyploid | FALSE | FALSE | FALSE | DEATH IN CR | | <NA> |
| ## NA.1 | <NA> | NA | NA | NA | <NA> | | <NA> |
| ## 12012 | dyploid | NA | NA | NA | <NA> | | <NA> |
| ## 12019 | dyploid | TRUE | FALSE | FALSE | CCR | 6/6/2002 | |
| ## 12026 | dyploid | FALSE | FALSE | FALSE | DEATH IN CR | | <NA> |
| ## NA.2 | <NA> | NA | NA | NA | <NA> | | <NA> |
| ## 15001 | dyploid | TRUE | FALSE | FALSE | CCR | 6/21/2002 | |
| ## 16004 | dyploid | FALSE | TRUE | FALSE | REL | 12/9/1997 | |
| ## 16009 | dyploid | TRUE | FALSE | FALSE | CCR / OFF | 5/23/2002 | |
| ## 19005 | dyploid | FALSE | TRUE | FALSE | REL | 2/4/1998 | |
| ## 20002 | dyploid | FALSE | TRUE | FALSE | REL | 12/15/1997 | |
| ## 22009 | dyploid | NA | NA | NA | <NA> | | <NA> |
| ## 22010 | dyploid | NA | NA | NA | <NA> | | <NA> |
| ## 22011 | dyploid | TRUE | FALSE | FALSE | CCR | 7/31/2002 | |
| ## NA.3 | <NA> | NA | NA | NA | <NA> | | <NA> |
| ## 24001 | dyploid | FALSE | TRUE | FALSE | REL | 2/10/1997 | |
| ## 24005 | dyploid | FALSE | TRUE | FALSE | REL | 8/28/1997 | |
| ## 24008 | dyploid | FALSE | FALSE | TRUE | BMT / CCR | 00/09/20+T12501 | |
| ## 24010 | dyploid | FALSE | TRUE | TRUE | BMT / REL | 8/24/1998 | |
| ## 24011 | dyploid | NA | NA | NA | <NA> | | <NA> |
| ## 24018 | dyploid | FALSE | TRUE | FALSE | REL | 7/22/2000 | |
| ## 24022 | dyploid | NA | NA | NA | <NA> | | <NA> |
| ## 25003 | dyploid | TRUE | FALSE | FALSE | CCR | 6/10/2002 | |
| ## 25006 | <NA> | TRUE | FALSE | FALSE | CCR | 3/3/2002 | |
| ## 26001 | dyploid | TRUE | FALSE | FALSE | CCR | 7/31/2002 | |
| ## 26003 | dyploid | FALSE | TRUE | FALSE | REL | 7/1/1998 | |
| ## 26008 | dyploid | FALSE | TRUE | FALSE | REL | 6/26/2000 | |
| ## 27003 | dyploid | FALSE | TRUE | FALSE | REL | 5/6/1998 | |
| ## 27004 | dyploid | NA | NA | NA | <NA> | | <NA> |
| ## NA.4 | <NA> | NA | NA | NA | <NA> | | <NA> |

| | | | | | | |
|----------|---------|-------|-------|-------|-------------------|------------|
| ## 28003 | hyperd. | TRUE | FALSE | FALSE | CCR | 12/31/2002 |
| ## 28007 | dyploid | TRUE | FALSE | FALSE | CCR | 3/22/2002 |
| ## 28019 | hyperd. | TRUE | FALSE | TRUE | BMT / CCR | 3/21/2001 |
| ## 28021 | hyperd. | FALSE | FALSE | FALSE | DEATH IN CR (ICR) | <NA> |
| ## 28024 | hyperd. | TRUE | FALSE | FALSE | CCR | 12/31/2002 |
| ## 28032 | dyploid | TRUE | FALSE | FALSE | CCR | 5/16/2002 |
| ## 28035 | hyperd. | TRUE | FALSE | FALSE | CCR | 5/20/2002 |
| ## 30001 | hyperd. | NA | NA | NA | <NA> | <NA> |
| ## 33005 | dyploid | TRUE | FALSE | FALSE | CCR | 6/28/2002 |
| ## 36001 | dyploid | FALSE | TRUE | FALSE | REL | 1/7/1998 |
| ## NA.5 | <NA> | NA | NA | NA | <NA> | <NA> |
| ## 43004 | dyploid | TRUE | FALSE | FALSE | CCR | 3/20/2001 |
| ## 43007 | hyperd. | TRUE | FALSE | FALSE | CCR | 5/29/2002 |
| ## 48001 | hyperd. | FALSE | FALSE | FALSE | MUD / DEATH IN CR | 12/18/1998 |
| ## 49006 | dyploid | FALSE | TRUE | FALSE | REL | 4/26/1999 |
| ## 57001 | hyperd. | NA | NA | NA | <NA> | <NA> |
| ## 62001 | hyperd. | NA | NA | NA | <NA> | <NA> |
| ## NA.6 | <NA> | NA | NA | NA | <NA> | <NA> |
| ## 64002 | hyperd. | FALSE | FALSE | TRUE | BMT / DEATH IN CR | <NA> |
| ## NA.7 | <NA> | NA | NA | NA | <NA> | <NA> |
| ## 68001 | dyploid | TRUE | FALSE | FALSE | CCR | 5/10/2002 |
| ## 68003 | <NA> | NA | NA | NA | <NA> | <NA> |
| ## NA.8 | <NA> | NA | NA | NA | <NA> | <NA> |
| ## 01007 | hyperd. | FALSE | FALSE | TRUE | BMT / DEATH IN CR | <NA> |
| ## 02020 | dyploid | NA | NA | NA | <NA> | <NA> |
| ## 04018 | dyploid | TRUE | FALSE | FALSE | CCR | 5/14/2001 |
| ## 09002 | dyploid | FALSE | TRUE | FALSE | REL / SNC | 9/14/1999 |
| ## NA.9 | <NA> | NA | NA | NA | <NA> | <NA> |
| ## 16007 | dyploid | TRUE | FALSE | FALSE | CCR | 1/8/2002 |
| ## 17003 | dyploid | NA | NA | NA | <NA> | <NA> |
| ## 18001 | hyperd. | NA | NA | NA | <NA> | <NA> |
| ## 19008 | dyploid | NA | NA | NA | <NA> | <NA> |
| ## 20005 | dyploid | TRUE | FALSE | FALSE | CCR | 3/20/2002 |
| ## 24006 | dyploid | TRUE | FALSE | FALSE | CCR | 6/5/2002 |
| ## 28008 | hyperd. | TRUE | FALSE | FALSE | CCR | 4/9/2002 |
| ## 28009 | dyploid | FALSE | TRUE | FALSE | REL | 6/30/1998 |
| ## NA.10 | <NA> | NA | NA | NA | <NA> | <NA> |
| ## NA.11 | <NA> | NA | NA | NA | <NA> | <NA> |
| ## 49004 | dyploid | TRUE | FALSE | FALSE | CCR | 6/14/2001 |
| ## 56007 | dyploid | TRUE | FALSE | FALSE | CCR | 1/26/2001 |
| ## NA.12 | <NA> | NA | NA | NA | <NA> | <NA> |
| ## 83001 | hyperd. | TRUE | FALSE | FALSE | CCR | 5/24/2002 |
| ## NA.13 | <NA> | NA | NA | NA | <NA> | <NA> |

Chapter 4

Module 2

4.1 Lecture

4.1.1 2A

4.1.2 2B

4.2 Lab 2A

4.2.1 Read data in to R

4.2.2 read CSV - base functions

```
bp <- read.csv2("Desktop/R/data/BloodPressure_Data.csv") # no sepgration
# take a quick look at the data
head(bp)
```

```
bp <- read.csv2("Desktop/R/data/BloodPressure_Data.csv", sep = ",") # no sepgration
# take another look at the data
head(bp)
str(bp)
```

```
# readr functions
library(readr)
```

```
# Read the CSV file  
bp_data <- read_csv("Desktop/R/data/BloodPressure_Data.csv")
```

```
# Take a quick look at the data  
head(bp_data)  
str(bp_data)
```

```
# Work with date  
library(readr)  
library("lubridate")
```

```
# read ALL data  
bp <- read_csv2("Desktop/R/data/BloodPressure_wDates.csv", sep = ",")
```

```
# Convert date column and extract year  
bp$Date <- ymd(bp$Date)  
bp$Year <- year(bp$Date)
```

```
# Filtering blood pressure patients by year and gender  
subset(bp, Year == 2003 & Gender == "f")
```

Chapter 5

Module 3

5.1 Lecture

5.1.1 3A

5.1.2 3B

5.2 Lab

Chapter 6

Module 4

6.1 Lecture

6.1.1 4A

6.1.2 4B

6.2 Lab