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Bios 6301: Assignment 8

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Due Tuesday, 16 November, 1:00 PM

$5^{n=day}$ points taken off for each day late.

30 points total.

Submit a single knitr file (named `homework8.rmd`), along with a valid PDF output file. Inside the file, clearly indicate which parts of your responses go with which problems (you may use the original homework document as a template). Add your name as `author` to the file's metadata section. Raw R code/output or word processor files are not acceptable.

Failure to name file `homework8.rmd` or include author name may result in 5 points taken off.

Question 1

15 points

Install the `readxl` package and run the following

```
fn <- 'icd10.xlsx'
if(file.access(fn, mode = 4) == -1) {
    url <- "https://www.cdc.gov/nhsn/xls/icd10-pcs-pcm-nhsn-opc.xlsx"
    download.file(url, destfile = fn, mode = 'wb')
}
dat <- readxl::read_excel(fn, sheet = 2)
```

1. Show the class of `dat`. (1 point)

```
class(dat)
```

```
## [1] "tbl_df"     "tbl"        "data.frame"
```

2. Show the methods available for objects of the given class (if there are multiple classes, show methods for all classes). (3 points)

```
for(i in 1:length(class(dat))){
  print(methods(class=class(dat)[i]))
}
```

```
##  [1] [             [[            [[<-          [<-           $
##  [6] $<-           as.data.frame coerce        initialize    names<-
## [11] Ops           row.names<-   show          slotsFromS3   str
## see '?methods' for accessing help and source code
##  [1] [[<-        [<-         $<-         coerce      format      initialize
##  [7] Ops         print       show        slotsFromS3
## see '?methods' for accessing help and source code
##  [1] [             [[            [[<-          [<-           $<-
##  [6] aggregate     anyDuplicated anyNA         as.data.frame as.list
## [11] as.matrix     by            cbind         coerce        dim
## [16] dimnames      dimnames<-    droplevels    duplicated    edit
```

```
## [21] format        formula       head          initialize    is.na
## [26] Math          merge         na.exclude    na.omit       Ops
## [31] plot          print         prompt        rbind         row.names
## [36] row.names<-   rowsum        show          slotsFromS3   split
## [41] split<-       stack         str           subset        summary
## [46] Summary       t             tail          transform     type.convert
## [51] unique        unstack       within
## see '?methods' for accessing help and source code
```

3. If you call `print(dat)`, what print method is being dispatched? (1 point)

```
findMethod <- function(generic, ...) {
  ch <- deparse(substitute(generic))
  f <- X <- function(x, ...) UseMethod("X")
  for(m in methods(ch)) assign(sub(ch, "X", m, fixed = TRUE), "body<-"(f, value = m))
  X(...)
}

findMethod(print, dat)
```

```
## [1] "print.tbl"
```

4. Set the class of `dat` to be a data.frame. (1 point)

```
class(dat) <- "data.frame"
```

5. If you call `print(dat)` again, what print method is being dispatched? (1 point)

```
findMethod(print, dat)
```

```
## [1] "print.data.frame"
```

Define a new generic function `nUnique` with the code below.

```
nUnique <- function(x) {
    UseMethod('nUnique')
}
```

6. Write a default method for `nUnique` to count the number of unique values in an element. (2 points)

```
nUnique.default <- function(x) {
  length(unique(x))
}
```

7. Check your function (2 points)

```
nUnique(letters) # should return 26
```

```
## [1] 26
```

```
nUnique(sample(10, 100, replace = TRUE)) # should return 10 (probably)
```

```
## [1] 10
```

8. Write a data.frame method for `nUnique` to operate on data.frame objects. This version should return counts for each column in a data.frame. (2 points)

```
nUnique.data.frame <- function(x) {
data <- c()

for(i in 1: ncol(x)){
  data <-c(data, length(sapply(x, unique)[[i]]))
```

```
}
names(data) <- colnames(x)
print(data)
}
```

9. Check your function (2 points)

```
nUnique(dat)
```

```
##     Procedure Code Category            ICD-10-PCS Codes
##                          39                        9697
## Procedure Code Descriptions                 Code Status
##                        9697                           4
```

Question 2

15 points

Programming with classes. The following function will generate random patient information.

```
makePatient <- function() {
  vowel <- grep("[aeiou]", letters)
  cons <- grep("[^aeiou]", letters)
  name <- paste(sample(LETTERS[cons], 1), sample(letters[vowel], 1), sample(letters[cons], 1), sep='')
  gender <- factor(sample(0:1, 1), levels=0:1, labels=c('female','male'))
  dob <- as.Date(sample(7500, 1), origin="1970-01-01")
  n <- sample(6, 1)
  doa <- as.Date(sample(1500, n), origin="2010-01-01")
  pulse <- round(rnorm(n, 80, 10))
  temp <- round(rnorm(n, 98.4, 0.3), 2)
  fluid <- round(runif(n), 2)
  list(name, gender, dob, doa, pulse, temp, fluid)
}
```

1. Create an S3 class `medicalRecord` for objects that are a list with the named elements `name`, `gender`, `date_of_birth`, `date_of_admission`, `pulse`, `temperature`, `fluid_intake`. Note that an individual patient may have multiple measurements for some measurements. Set the RNG seed to `8` and create a medical record by taking the output of `makePatient`. Print the medical record, and print the class of the medical record. (5 points)

```
set.seed(8)
patient <- makePatient()

names(patient) <- c("name", "gender", "date_of_birth", "date_of_admission",
                    "pulse", "temperature", "fluid_intake")
class(patient) <- 'medicalRecord'
print(patient)
```

```
## $name
## [1] "Yes"
##
## $gender
## [1] male
## Levels: female male
##
## $date_of_birth
## [1] "1977-05-03"
```

```
##
## $date_of_admission
## [1] "2013-06-09" "2013-07-02"
##
## $pulse
## [1] 79 78
##
## $temperature
## [1] 98.07 97.50
##
## $fluid_intake
## [1] 0.28 0.52
##
## attr(,"class")
## [1] "medicalRecord"
```

```
attributes(patient)
```

```
## $names
## [1] "name"              "gender"            "date_of_birth"
## [4] "date_of_admission" "pulse"             "temperature"
## [7] "fluid_intake"
##
## $class
## [1] "medicalRecord"
```

2. Write a `medicalRecord` method for the generic function `mean`, which returns averages for pulse, temperature and fluids. Also write a `medicalRecord` method for `print`, which employs some nice formatting, perhaps arranging measurements by date, and `plot`, that generates a composite plot of measurements over time. Call each function for the medical record created in part 1. (5 points)

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
mean.medicalRecord <- function(x) {
  vector <- c(mean(x$pulse), mean(x$temperature), mean(x$fluid_intake))
  names(vector) <- c("pulse", "temperature", "fluid_intake")
  print(vector)
}

print.medicalRecord <- function(x) {
  data <- data.frame(matrix(NA, length(x$date_of_admission), length(x)))
  for(i in 1:length(x)){
  data[,i] <- x[[i]]
  }
  colnames(data) <- names(x)
  data <- arrange(data,date_of_admission)
```

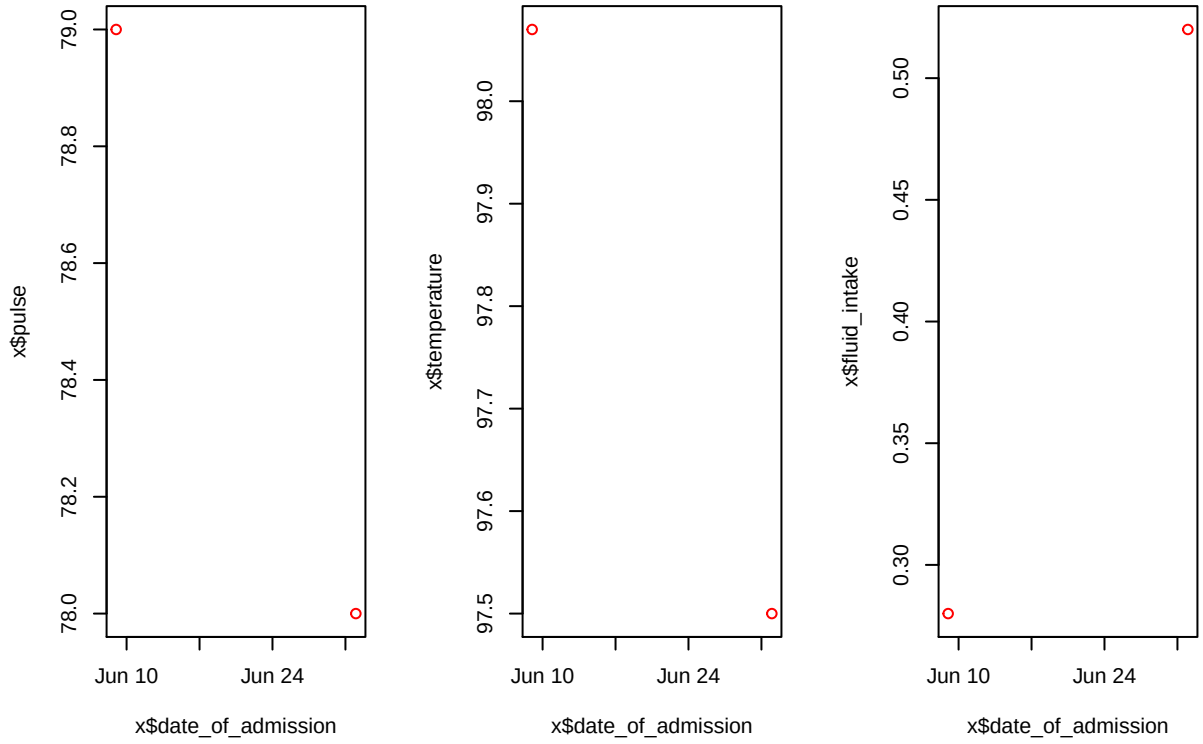
```
  data
}

plot.medicalRecord <- function(x) {
  par(mfrow = c(1,3))
  plot(x$date_of_admission, x$pulse, col = 'red')
  plot(x$date_of_admission, x$temperature, col = 'red')
  plot(x$date_of_admission, x$fluid_intake, col = 'red')
}

mean(patient)
```

```
##        pulse  temperature fluid_intake
##       78.500       97.785        0.400
```

```
print(patient)
```

```
##   name gender date_of_birth date_of_admission pulse temperature fluid_intake
## 1  Yes   male    1977-05-03        2013-06-09    79       98.07         0.28
## 2  Yes   male    1977-05-03        2013-07-02    78       97.50         0.52
```

```
plot(patient)
```



3. Create a further class for a cohort (group) of patients, and write methods for `mean` and `print` which, when applied to a cohort, apply mean or print to each patient contained in the cohort. Hint: think of this as a "container" for patients. Reset the RNG seed to 8 and create a cohort of ten patients, then show the output for `mean` and `print`. (5 points)

```
set.seed(8)

cohort <- list()
```

```
for(i in 1:10) {
patient <- makePatient()
names(patient) <-  c("name", "gender", "date_of_birth", "date_of_admission",
                     "pulse", "temperature", "fluid_intake")
# class(patient) <- "medicalRecord"
cohort[[i]] <- patient
}

class(cohort) <- "medicalCohort"

mean.medicalCohort <- function(x){
  mat <- matrix(NA, 10, 3)
  for(i in 1:10) {
    mat[i,] <- mean.medicalRecord(x[[i]])
  }
  colMeans(mat)
}

mean(cohort)
```

```
##        pulse  temperature fluid_intake
##       78.500       97.785        0.400
##        pulse  temperature fluid_intake
##   86.3333333   98.3966667    0.4133333
##        pulse  temperature fluid_intake
##      77.0000      98.6475       0.5200
##        pulse  temperature fluid_intake
##   83.1666667   98.4850000    0.2966667
##        pulse  temperature fluid_intake
##      83.5000      98.4500       0.4525
##        pulse  temperature fluid_intake
##       84.400       98.484        0.522
##        pulse  temperature fluid_intake
##      76.5000      98.3800       0.3975
##        pulse  temperature fluid_intake
##      75.0000      98.3675       0.5225
##        pulse  temperature fluid_intake
##        73.00        98.36         0.15
##        pulse  temperature fluid_intake
##        77.00        98.54         0.15
```

```
## [1] 79.44000 98.38957  0.38245
```

```
print.medicalCohort <- function(x) {
  dat <- data.frame()
  for(i in 1:10) {
    dat <- rbind(dat, print.medicalRecord(cohort[[i]]))
  }
  dat
}

print(cohort)
```

```
##    name gender date_of_birth date_of_admission pulse temperature fluid_intake
## 1   Yes   male    1977-05-03        2013-06-09    79       98.07         0.28
```

```
## 2   Yes   male    1977-05-03        2013-07-02    78       97.50         0.52
## 3   Fal   male    1988-05-24        2010-11-16    76       98.23         0.18
## 4   Fal   male    1988-05-24        2013-03-24    87       98.21         0.10
## 5   Fal   male    1988-05-24        2013-09-12    96       98.75         0.96
## 6   Zog   male    1988-12-14        2010-02-24    84       98.54         0.40
## 7   Zog   male    1988-12-14        2013-03-25    69       98.49         0.81
## 8   Zog   male    1988-12-14        2013-07-29    75       98.82         0.59
## 9   Zog   male    1988-12-14        2013-10-27    80       98.74         0.28
## 10  Yol   male    1986-03-11        2010-02-22    84       98.87         0.39
## 11  Yol   male    1986-03-11        2011-12-27    89       98.27         0.97
## 12  Yol   male    1986-03-11        2012-03-10    87       98.78         0.12
## 13  Yol   male    1986-03-11        2012-11-26    92       98.26         0.14
## 14  Yol   male    1986-03-11        2013-03-24    78       98.44         0.13
## 15  Yol   male    1986-03-11        2014-01-28    69       98.29         0.03
## 16  Yak female    1983-09-15        2011-07-19    75       98.58         0.60
## 17  Yak female    1983-09-15        2012-04-07    88       97.53         0.29
## 18  Yak female    1983-09-15        2012-07-11    81       99.11         0.66
## 19  Yak female    1983-09-15        2012-08-30    90       98.58         0.26
## 20  Gaf female    1978-04-27        2010-07-19    91       98.01         0.47
## 21  Gaf female    1978-04-27        2011-05-03    90       98.61         0.36
## 22  Gaf female    1978-04-27        2012-04-24    89       98.32         0.42
## 23  Gaf female    1978-04-27        2012-08-06    77       98.96         0.74
## 24  Gaf female    1978-04-27        2013-08-21    75       98.52         0.62
## 25  Kuw female    1980-11-07        2010-10-03    82       98.49         0.12
## 26  Kuw female    1980-11-07        2010-10-29    81       98.17         0.93
## 27  Kuw female    1980-11-07        2011-09-16    72       98.21         0.29
## 28  Kuw female    1980-11-07        2012-07-10    71       98.65         0.25
## 29  Mav female    1989-07-16        2010-02-08    66       97.95         0.79
## 30  Mav female    1989-07-16        2010-04-19    88       98.00         0.50
## 31  Mav female    1989-07-16        2010-06-11    83       98.45         0.79
## 32  Mav female    1989-07-16        2012-03-02    63       99.07         0.01
## 33  Fel   male    1985-08-16        2010-09-26    81       98.51         0.24
## 34  Fel   male    1985-08-16        2012-06-24    65       98.21         0.06
## 35  Say female    1974-09-22        2010-03-14    77       98.54         0.15
```