Factors and levels

plotting in R
Models
} Categorical data

R for data Science : (Book)

dplyr
forcats
package

keys :- How base-R handles categorical data or variables ?

R- Categorical Data –Factors and Levels

- Categorical Variables- Qualitative variables, i.e. those which cannot meaningfully be expressed in numbers. E.g.: Clothes Colour.
  - Base-R deals with them through the use of factors.
  - factors are useful in Statistical Modeling and Plotting data.
- Packages - tidyverse- dplyr, tidyr, forcats, readr help in dealing with factors.
- Many get frustrated with factors and use these to avoid them!

- storing data as factors will ensure modeling / plot functions treat such data correctly.
- factor() – function that is used to create a factor.
  - Used to work with Categorical data

R- Categorical Data – Factors and Levels

```
> xc = c("June", "July", "August", "September",
+        "August", "July","July","August" )
> factorxc  = factor(xc)
> factorxc
[1] June      July      August    September August
[6] July      July      August
Levels: August July June September
```

- x - vector of data.
- factor(x) in R is stored as a vector of integers, but correspond to a character string for display.
- Levels - the unique set of values taken by as.chararcter(x)

```
> xn = c(1,2,2,3,1,2,3,3,1,2,3,3,1)
> factorxn  = factor(xn)
> factorxn
 [1] 1 2 2 3 1 2 3 3 1 2 3 3 1
Levels: 1 2 3
```

factor(x)

- store as vector of integers
- displayed as characters
- Levels :- assigned by default are those given by as.character(x)

- store both

xc – character data

xn – numeric

as factors.

- factor levels are always characters

R- Categorical Data – Factors and Levels

```
> xn = c(1,2,2,3,1,2,3,3,1,2,3,3,1)
> factorxn  = factor(xn)
> factorxn
 [1] 1 2 2 3 1 2 3 3 1 2 3 3 1
Levels: 1 2 3

> mean(xn)
[1] 2.076923
> mean(factorxn)
[1] NA
> mean(as.numeric(levels(factorxn)[factorxn]))
[1] 2.076923
```

Doing Computations with numeric

{ argument is not numeric
so will return NA

- use levels function to convert them to original numeric value

R- Categorical Data– Factors and Levels

Specify ordering of Levels

```
> table(factorxc)
factorxc
   August      July      June September
        3         3         1         1
```

```
> months = factor(xc,levels=c("Garbage", "January","February",
+     "March","April","May","June","July","August",
+     "September","October","November","December"),
+     ordered=TRUE)
> months
[1] June      July      August    September August
[6] July      July      August
13 Levels: Garbage < January < February < ... < December
> months[3] < months[4]
[1] TRUE
```

- in our specification levels contain elements not present in xc

Previous - slide - defined

```
> xc = c("June", "July", "August", "September",
+        "August", "July","July","August" )
> factorxc  = factor(xc)
```

```
> factorxc
[1] June      July      August    September August
[6] July      July      August
Levels: August July June September
```

- ordering is w.r.t to as.character(.) and not related to order in months.

- Specify Levels needed
- order can be specified.

R- Categorical Data– Factors and Levels

```
> table(months)

months
  Garbage   January  February     March     April       May
        0         0         0         0         0         0
     June      July    August September   October  November
        1         3         3         1         0         0
 December
        0
```

```
> table(factor(months))

     June      July    August September
        1         3         3         1
```

Previous slide

```
> months = factor(xc,levels=c("Garbage", "January","February"
+     "March","April","May","June","July","August",
+     "September","October","November","December"),
+     ordered=TRUE)
```

- When factor is created, all its levels are stored along with the factor
- Display. All levels specified and counts
- occur when subsetting a factor.

- factor (months)
  - retains only the levels present
  - maintain the ordering.

R- Categorical Data– cut

```
> x = round(1000*runif(10))
> x
 [1] 707  26 211 929   2 549 225 135 191 383

> xfactor= cut(x,4)
> xfactor
 [1] (697,930]  (1.07,234] (1.07,234] (697,930]  (1.07,234]
 [6] (466,697]  (1.07,234] (1.07,234] (1.07,234] (234,466]
Levels: (1.07,234] (234,466] (466,697] (697,930]
> table(xfactor)
xfactor
(1.07,234]  (234,466]  (466,697]  (697,930]
         6          1          1          2
```

- cut - function is used to convert a numeric variable into a factor.
- cut(____ , ____)
  - ____ ← numeric data
  - ____ ← breaks

how range of numbers will be converted to factor values

Exercise:

labels - Specify levels of factors

```
cut (x, 3, labels = c("L","M","H"))
```

R- Categorical Data– cut

```
> xpfactor= cut(x,pretty(x,4))
> xpfactor
 [1] (600,800]   (0,200]     (200,400]   (800,1e+03]
 [5] (0,200]     (400,600]   (200,400]   (0,200]
 [9] (0,200]     (200,400]
5 Levels: (0,200] (200,400] (400,600] ... (800,1e+03]
> table(xpfactor)
xpfactor
   (0,200]   (200,400]   (400,600]   (600,800] (800,1e+03]
         4           3           1           1           1
```

- nicer set of labels
- but may provide more levels than specified.

```
> xqfactor= cut(x,quantile(x, probs=seq(0,1,0.25)))
> table(xqfactor)
xqfactor
  (2,149] (149,218] (218,508] (508,929]
        2         2         2         3
```

- produce factors based on percentiles of your data.
- insure "equal" number of observations in each level

R – Factors and Levels

```
> everyday = seq(from=as.Date('2021-1-1'),
+                to=as.Date('2021-12-31'), by='day')
> cmonth = format(everyday,'%b')
> head(cmonth,3)
[1] "Jan" "Jan" "Jan"
> df= as.data.frame(table(cmonth))
> names(df)=c("Month", "Freq")
> df
   Month Freq
1    Apr   30
2    Aug   31
3    Dec   31
4    Feb   28
5    Jan   31
6    Jul   31
7    Jun   30
8    Mar   31
9    May   31
10   Nov   30
11   Oct   31
12   Sep   30
```

- Create factors from dates/times
  - strptime
  - strftime

  } extract information

- extract month from each day
- table – tabulates values in each month
- ordering is alphabetical

R – Factors and Levels

```
> everyday = seq(from=as.Date('2021-1-1'),
+                to=as.Date('2021-12-31'), by='day')
> cmonth = format(everyday,'%b')
> months = factor(cmonth,levels=unique(cmonth),ordered=TRUE)
> head(months,3)
[1] Jan Jan Jan
12 Levels: Jan < Feb < Mar < Apr < May < Jun < ... < Dec
> df2= as.data.frame(table(months))
> names(df2)= c("Month", "Freq")
> df2
   Month Freq
1    Jan   31
2    Feb   28
3    Mar   31
4    Apr   30
5    May   31
6    Jun   30
7    Jul   31
8    Aug   31
9    Sep   30
10   Oct   31
11   Nov   30
12   Dec   31
```

format() : can be used to extract months using %b

unique() :- returns the unique values in the order that they are encountered

- stored months as factors
- specified levels & ordering using the unique()

R – Factors and Levels

```
> decdf= read.csv(file="  , Master.csv", header=TRUE)
> decdf$Month= months(as.Date(decdf$MB.Date))
> data = as.data.frame(table(decdf$Month))
> names(data) = c("Month", "val")
> data
```

	Month	val
1	April	2974
2	August	4108
3	December	430
4	February	483
5	January	843
6	July	3561
7	June	6049
8	March	239
9	May	13599
10	November	737
11	October	2593
12	September	3643

Master.csv

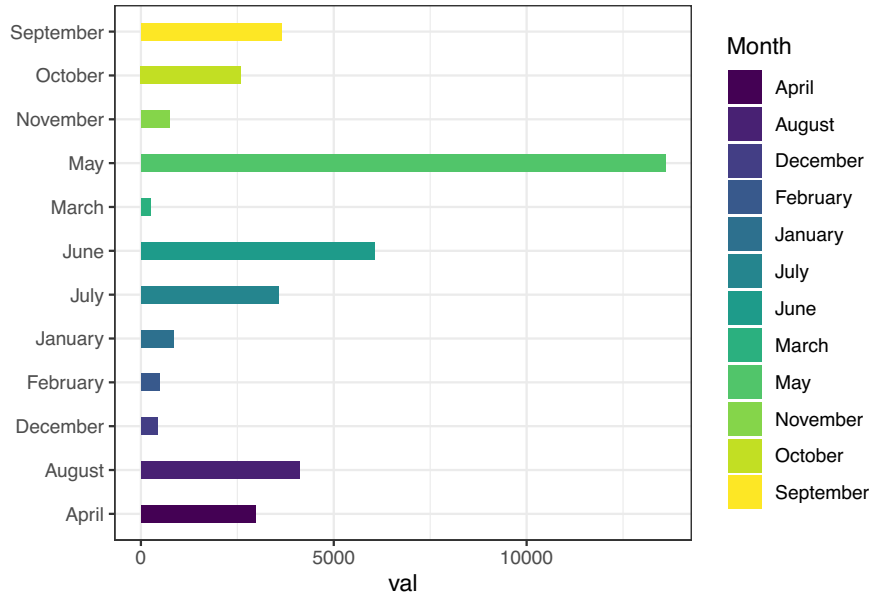
- Deceased data from KA – COVID-19 bulletins.

- Use months( ) to extract month of reporting date

- Use table() to compute reported case across months

R – Factors and Levels

```
> library(tidyverse)
> ggplot(data=data, aes(x=Month, y=val,  fill=Month)) +
+   geom_bar(stat="identity", width=.4) +
+   coord_flip() +
+     scale_fill_viridis_d()+
+   xlab("") +
+   theme_bw()
```



Previous slide

```
> decdf= read.csv(file="  , Master.csv", header=TRUE)
> decdf$Month= months(as.Date(decdf$MB.Date))
> data = as.data.frame(table(decdf$Month))
> names(data) = c("Month", "val")
> data
```

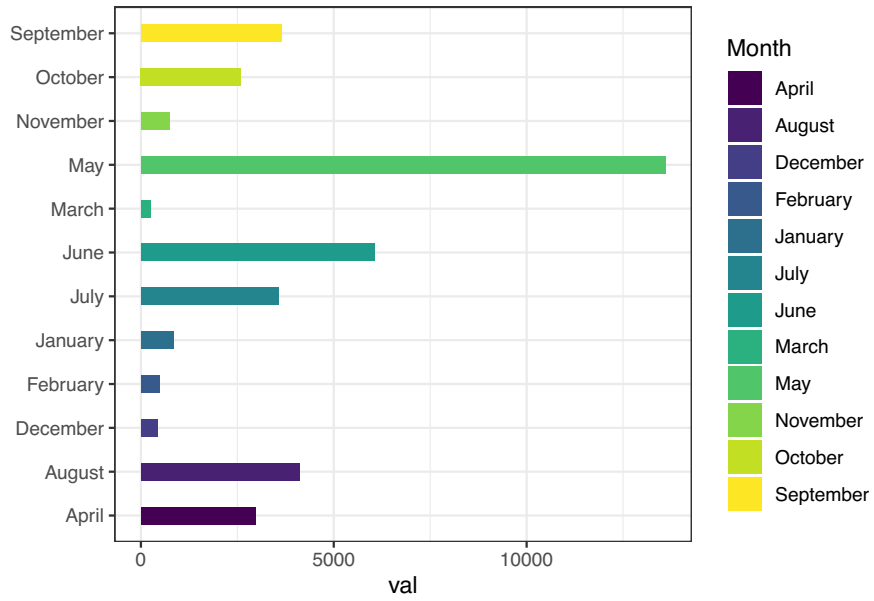
- Notice :-

- ggplot uses ordering alphabetically

- treats Month as factor and default level ordering

R – Factors and Levels

```
> library(tidyverse)
> data  = arrange(data, val)
> ggplot(data=data, aes(x=Month, y=val,  fill=Month)) +
+   geom_bar(stat="identity", width=.4) +
+   scale_fill_viridis_d()+
+   coord_flip() +
+   xlab("") +
+   theme_bw()
```



Note: ggplot() takes into account ordering from the factor given by its levels

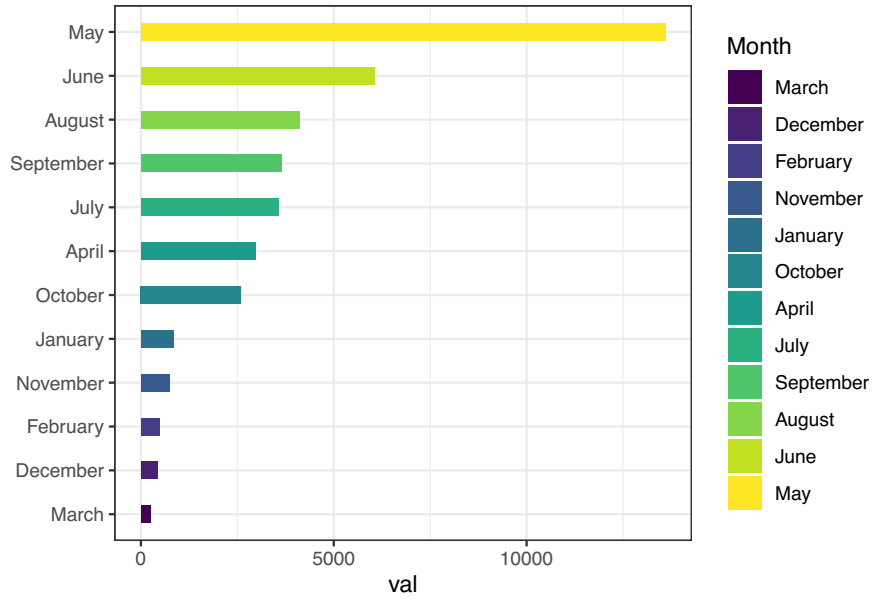
and

NOT

as you see it in the data frame

R – Factors and Levels

```
> library(tidyverse)
> data  = arrange(data, val)
> data$Month= factor(data$Month, levels=data$Month)
> ggplot(data=data, aes(x=Month, y=val, fill=Month)) +
+   geom_bar(stat="identity", width=.4) +
+   coord_flip() +
+   scale_fill_viridis_d()+
+   xlab("") +
+   theme_bw()
```



Re order the levels according to the values

- ggplot() will then oblige

R - With Dplyr — Order months according to reported deaths

```
> decdf= read.csv(file="../Master.csv", header=TRUE)
> names(decdf) = c("Sno","District","Pid","Age","Sex", "Description","Symptoms",
+                  "CMB", "DOA","DOD","MB.Date","Notes")
> decdf$Month= months(as.Date(decdf$MB.Date))
> ggplot(decdf, aes(x = fct_infreq(Month), fill=cut(Age,pretty(Age,4)))) +labs(fill='Age')+
+ geom_bar(stat="count", width=.4) + scale_fill_viridis_d()+
+   coord_flip()+ theme_bw() +ggtitle("Deceased Month Count- Age Stacked")+ ylab("Count of Deceased") +
+   xlab("Month") + theme_bw()+ theme(plot.title = element_text( color="#e95462",size=14, face="bold",hjust = 0.5))+
+   theme(axis.title.x = element_text( color="#e95462", size=14, vjust = 0.5,face="bold"),
+         axis.title.y = element_text(color="#e95462", size=14, face="bold") )
```

Use forcats package fct_infreq

cut - add Age bin layer.

format labels