Transformations

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Baby names

Top 1000 male and female baby names in the US, from 1880 to 2008.

258,000 records (1000 * 2 * 129)

But only four variables: year, name, sex and prop.

```
> head(bnames, 15)
   year    name  percent sex
1  1880    John 0.081541 boy
2  1880 William 0.080511 boy
3  1880   James 0.050057 boy
4  1880 Charles 0.045167 boy
5  1880  George 0.043292 boy
6  1880   Frank 0.027380 boy
7  1880  Joseph 0.022229 boy
8  1880  Thomas 0.021401 boy
9  1880   Henry 0.020641 boy
10 1880  Robert 0.020404 boy
11 1880  Edward 0.019965 boy
12 1880   Harry 0.018175 boy
13 1880  Walter 0.014822 boy
14 1880  Arthur 0.013504 boy
15 1880    Fred 0.013251 boy
```

```
> tail(bnames, 15)
        year     name  percent  sex
257986 2008   Neveah 0.000130 girl
257987 2008   Amaris 0.000129 girl
257988 2008 Hadassah 0.000129 girl
257989 2008    Dania 0.000129 girl
257990 2008   Hailie 0.000129 girl
257991 2008   Jamiya 0.000129 girl
257992 2008    Kathy 0.000129 girl
257993 2008   Laylah 0.000129 girl
257994 2008     Riya 0.000129 girl
257995 2008     Diya 0.000128 girl
257996 2008 Carleigh 0.000128 girl
257997 2008    Iyana 0.000128 girl
257998 2008   Kenley 0.000127 girl
257999 2008   Sloane 0.000127 girl
258000 2008  Elianna 0.000127 girl
```

Getting started

```
library(plyr)
bnames <- read.csv("baby-names.csv",
  stringsAsFactors = FALSE)

library(ggplot2)
qplot(year, prop, colour = sex,
  data = subset(bnames, name == "Hadley"),
  geom = "line")
```

Your turn

Extract your name from the dataset. Plot the trend over time (hint: use `geom="line"`).

Create a new variable that contains the first three (or four, or five) letters of each name. How many names start the same as yours? Plot the trend over time.

```
dian <- subset(bnames, substr(name, 1, 4) == "Dian")
qplot(year, prop, data = dian, geom = "line")
qplot(year, prop, data = dian, geom = "line",
  group = name)
qplot(year, prop, data = dian, geom = "line",
  group = interaction(name, sex))

qplot(year, prop, data = dian, geom = "line",
  colour = sex) + facet_wrap(~ name)
last_plot() + geom_point()
```

Brainstorm

Thinking about the data, what are some of the trends that you might want to explore? What additional variables would you need to create? What other data sources might you want to use?

Pair up and brainstorm for 2 minutes.

Some of my ideas

- First/last letter
- Length
- Number/percent of vowels
- Biblical names?
- Hurricanes?
- Rank
- Ecdf (how many babies have a name in the top 2, 3, 5, 100 etc)

```
letter <- function(x, n = 1) {
  if (n < 0) {
    nc <- nchar(x)
    n <- nc + n + 1
  }
  tolower(substr(x, n, n))
}
vowels <- function(x) {
  nchar(gsub("[^aeiou]", "", x))
}

bnames$length <- nchar(bnames$name)
table(bnames$length)
bnames[bnames$length == 2, ]
bnames[bnames$length == 10, ]

bnames$first <- letter(bnames$name, 1)
bnames$last <- letter(bnames$name, -1)
bnames$vowels <- vowels(bnames$name)
```

Very verbose!

Transform, summarise & subset

```
subset(df, subset)

transform(df, var1 = expr1, ...)

summarize(df, var1 = expr1, ...)
```

Subset selects rows from a data frame.
Transform modifies an existing data frame.
Summarise creates a new data frame. All evaluate arguments in scope of df.

```
bnames <- transform(bnames,
  first = letter(name, 1),
  last = letter(name, -1),
  vowels = vowels(name),
  length = nchar(name)
)

summarise(bnames,
  min_length = min(length),
  max_length = max(length)
)

subset(bnames, length == 2)
subset(bnames, length == 10)
```

Aside:
never use attach!

Non-local effects; not symmetric; implicit, not explicit.

Makes it very easy to make mistakes. Use `with()` instead.

```
with(bnames, table(year, length))
```

Group-wise

What about group-wise **transformations** or **summaries**? e.g. what if we want to compute the rank of a name within a sex and year?

This task is easy if we have a single year & sex, but hard otherwise.

Take two minutes to sketch out an approach

```
one <- subset(bnames, sex == "boy" & year == 2008)
one$rank <- rank(-one$prop,
  ties.method = "first")

# or
one <- transform(one,
  rank = rank(-prop, ties.method = "first"))
head(one)
```

What if we want to transform every sex and year?

```
# Split
pieces <- split(bnames,
  list(bnames$sex, bnames$year))

# Apply
results <- vector("list", length(pieces))
for(i in seq_along(pieces)) {
  piece <- pieces[[i]]
  piece <- transform(piece,
    rank = rank(-prop, ties.method = "first"))
  results[[i]] <- piece
}

# Combine
result <- do.call("rbind", results)
```

```
# Or equivalently

bnames <- ddply(bnames, c("sex", "year"), transform,
  rank = rank(-prop, ties.method = "first"))
```

```
# Or equivalent

bnames <- ddply(bnames, c("sex", "year"), transform,
  rank = rank(-prop, ties.method = "first"))
```

Input data

Way to split up input

Function to apply to each piece

2nd argument to `transform()`

Summaries

In a similar way, we can use `ddply()` for group-wise summaries.

There are many base R functions for special cases. Where available, these are often much faster; but you have to know they exist, and have to remember how to use them.

```
# Explore average length

wtd.mean <- function(x, weights)
  sum(weights * x) / sum(weights)

sy <- ddply(bnames, c("sex", "year"), summarise,
  avg_length = wtd.mean(length, prop))

qplot(year, avg_length, data = sy, colour = sex,
  geom = "line")
```

```
# Explore number of names of each length

syl <- ddply(bnames, c("sex", "length", "year"),
  summarise, prop = sum(prop))
qplot(year, prop, data = syl, colour = sex,
  geom = "line") + facet_wrap(~ length)

twoletters <- subset(bnames, length == 2)
unique(twoletters$name)
qplot(year, prop, data = twoletters, colour = sex,
  geom = "line") + facet_wrap(~ name)
```

Your turn

Use these tools to explore how the following have changed over time:

The total proportion of babies with names in the top 1000.

The number of vowels in a name.

The distribution of first (or last) letters.

```
sy <- ddply(bnames, c("year","sex"), summarise,
  prop = sum(prop),
  npop = sum(prop > 1/1000))

qplot(year, prop, data = sy, colour = sex,
  geom = "line")
qplot(year, npop, data = sy, colour = sex,
  geom = "line")


syl <- ddply(bnames, c("sex", "last", "year"),
  summarise, prop = sum(prop))
qplot(year, prop, data = syl, colour = sex,
  geom = "line") + facet_wrap(~ last)
```

More about plyr

Many problems involve splitting up a large data structure, operating on each piece and joining the results back together:

split-apply-combine

How you split up depends on the type of input: **arrays**, **data frames**, **lists**

How you combine depends on the type of output: **arrays**, **data frames**, **lists**, **nothing**

	array	data frame	list	nothing
array	aaply	adply	alply	a_ply
data frame	daply	ddply	dlply	d_ply
list	laply	ldply	llply	l_ply
n replicates	raply	rdply	rlply	r_ply
function arguments	maply	mdply	**mlply**	m_ply

	array	data frame	list	nothing
array	apply	adply	alply	a_ply
data frame	daply	*aggregate*	by	d_ply
list	sapply	ldply	lapply	l_ply
n replicates	replicate	rdply	replicate	r_ply
function arguments	mapply	mdply	mapply	m_ply

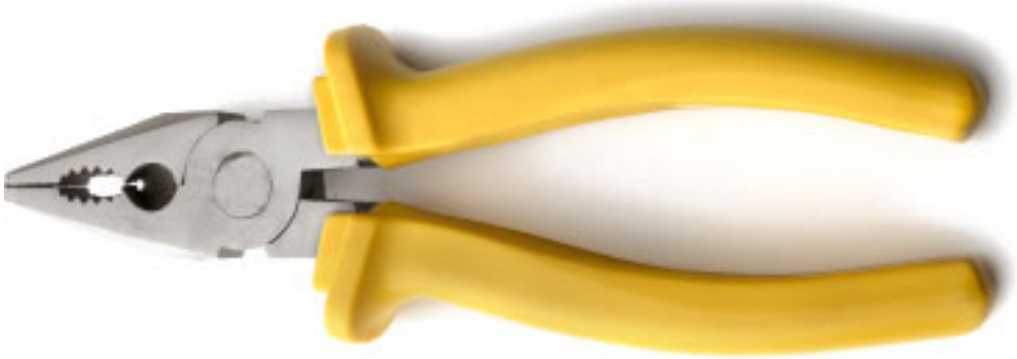
Fiddly details

Labelling

Progress bars

Consistent argument names

Missing values / Nulls



http://had.co.nz/plyr