

DEALING WITH DATA IN R

HOW TO USE DPLYR

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DATA TRANSFORMATION

Next up: data transformation. We'll be working with the **gapminder** data frame from the **gapminder** package, so make sure it's installed then load it:

```
## install.packages(c("gapminder", "dplyr"))  
library(dplyr) # for data transformation  
library(gapminder) # example data to work with
```

THE DATA

```
gapminder
```

```
## # A tibble: 1,704 x 6
```

```
##       country continent  year lifeExp      pop gdpPercap
##       <fctr>      <fctr> <int>   <dbl>    <int>    <dbl>
## 1  Afghanistan      Asia  1952  28.801  8425333  779.4453
## 2  Afghanistan      Asia  1957  30.332  9240934  820.8530
## 3  Afghanistan      Asia  1962  31.997 10267083  853.1007
## 4  Afghanistan      Asia  1967  34.020 11537966  836.1971
## 5  Afghanistan      Asia  1972  36.088 13079460  739.9811
## 6  Afghanistan      Asia  1977  38.438 14880372  786.1134
## 7  Afghanistan      Asia  1982  39.854 12881816  978.0114
## 8  Afghanistan      Asia  1987  40.822 13867957  852.3959
```

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Perform the above actions by groups - `group_by`

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 - Result is always a data frame

How to get only countries in Africa?

FILTER

How to get only countries in Africa?

```
filter(gapminder, continent == "Africa")
```

```
## # A tibble: 624 x 6
```

```
##   country continent  year lifeExp      pop gdpPercap
##   <fctr>    <fctr> <int>   <dbl>    <int>    <dbl>
## 1  Algeria    Africa  1952  43.077  9279525  2449.008
## 2  Algeria    Africa  1957  45.685 10270856  3013.976
## 3  Algeria    Africa  1962  48.303 11000948  2550.817
## 4  Algeria    Africa  1967  51.407 12760499  3246.992
## 5  Algeria    Africa  1972  54.518 14760787  4182.664
## 6  Algeria    Africa  1977  58.014 17152804  4910.417
## 7  Algeria    Africa  1982  61.368 20033753  5745.160
```

YOU TRY!

Get a data frame of all the countries in Europe in 1997

YOU TRY (ANSWER)

```
filter(gapminder, continent == "Europe", year == 1997)
```

```
## # A tibble: 30 x 6
```

```
##           country continent  year lifeExp      pop gdpPercap
##           <fctr>    <fctr> <int>   <dbl>    <int>    <dbl>
## 1      Albania    Europe  1997  72.950  3428038  3193.055
## 2      Austria    Europe  1997  77.510  8069876 29095.921
## 3      Belgium    Europe  1997  77.530 10199787 27561.197
## 4 Bosnia and Herzegovina Europe  1997  73.244  3607000  4766.356
## 5      Bulgaria    Europe  1997  70.320  8066057  5970.389
## 6      Croatia    Europe  1997  73.680  4444595  9875.605
## 7    Czech Republic Europe  1997  74.010 10300707 16048.514
## 8      Denmark    Europe  1997  76.110  5283663 29804.3468
```

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- Less than < (or equal to <=)

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AND, OR, AND %IN%

- `filter` automatically joins multiple arguments with `&`
- You can use `|` instead, which means “or”
- Try to get all the countries in Europe or Africa

```
filter(gapminder, continent == "Europe" | "Africa")
```

```
## Error in eval(expr, envir, enclos): operations are possible only for r
```

AND, OR, AND %IN%

```
filter(gapminder, continent %in% c("Europe", "Africa"))
```

```
## # A tibble: 984 x 6
```

```
##   country continent  year lifeExp      pop gdpPercap
##   <fctr>      <fctr> <int>   <dbl>   <int>     <dbl>
## 1 Albania     Europe  1952  55.230 1282697 1601.056
## 2 Albania     Europe  1957  59.280 1476505 1942.284
## 3 Albania     Europe  1962  64.820 1728137 2312.889
## 4 Albania     Europe  1967  66.220 1984060 2760.197
## 5 Albania     Europe  1972  67.690 2263554 3313.422
## 6 Albania     Europe  1977  68.930 2509048 3533.004
## 7 Albania     Europe  1982  70.420 2780097 3630.881
## 8 Albania     Europe  1987  72.000 3075321 3738.933
```

WHAT'S OR USED FOR?

```
filter(gapminder, continent == "Asia" | country == "Turkey")
```

```
## # A tibble: 408 x 6
```

```
##       country continent  year lifeExp      pop gdpPercap
##       <fctr>    <fctr> <int>   <dbl>    <int>    <dbl>
## 1  Afghanistan      Asia  1952  28.801  8425333  779.4453
## 2  Afghanistan      Asia  1957  30.332  9240934  820.8530
## 3  Afghanistan      Asia  1962  31.997 10267083  853.1007
## 4  Afghanistan      Asia  1967  34.020 11537966  836.1971
## 5  Afghanistan      Asia  1972  36.088 13079460  739.9811
## 6  Afghanistan      Asia  1977  38.438 14880372  786.1134
## 7  Afghanistan      Asia  1982  39.854 12881816  978.0114
## 8  Afghanistan      Asia  1987  40.822 13867957  852.3959
```

SELECT

Sometimes you'll want to keep only the columns you're interested in. `select` lets you do that:

```
select(gapminder, country, year, pop)
```

```
## # A tibble: 1,704 x 3
##       country  year    pop
##       <fctr> <int>   <int>
## 1 Afghanistan 1952  8425333
## 2 Afghanistan 1957  9240934
## 3 Afghanistan 1962 10267083
## 4 Afghanistan 1967 11537966
## 5 Afghanistan 1972 13079460
## 6 Afghanistan 1977 14880372
```

SELECT HELPER FUNCTIONS

`select` has some helper functions: `starts_with` and `ends_with` are among the most useful:

```
select(gapminder, starts_with("c"), pop)
```

```
## # A tibble: 1,704 x 3
```

```
##       country continent      pop
```

```
##       <fctr>    <fctr>    <int>
```

```
## 1  Afghanistan      Asia  8425333
```

```
## 2  Afghanistan      Asia  9240934
```

```
## 3  Afghanistan      Asia 10267083
```

```
## 4  Afghanistan      Asia 11537966
```

```
## 5  Afghanistan      Asia 13079460
```

```
## 6  Afghanistan      Asia 14880372
```

RENAME

You can use `select` to rename variables, but since it drops everything that it doesn't return, it oftentimes isn't good at that. `rename` does what you want it to, though:

```
rename(gapminder, population = pop)
```

```
## # A tibble: 1,704 x 6
```

```
##       country continent  year lifeExp population gdpPercap
##       <fctr>    <fctr> <int>   <dbl>         <int>         <dbl>
## 1  Afghanistan      Asia  1952  28.801      8425333      779.4453
## 2  Afghanistan      Asia  1957  30.332      9240934      820.8530
## 3  Afghanistan      Asia  1962  31.997     10267083      853.1007
## 4  Afghanistan      Asia  1967  34.020     11537966      836.1971
## 5  Afghanistan      Asia  1972  36.088     13079460      739.9811
## 6  Afghanistan      Asia  1977  38.438     14880372      786.1134
```


ARRANGE

```
arrange(gapminder, year)
```

```
## # A tibble: 1,704 x 6
```

```
##       country continent  year lifeExp      pop  gdpPercap
##       <fctr>    <fctr> <int>   <dbl>    <int>      <dbl>
## 1  Afghanistan      Asia  1952  28.801  8425333    779.4453
## 2    Albania      Europe  1952  55.230  1282697   1601.0561
## 3    Algeria      Africa  1952  43.077  9279525   2449.0082
## 4     Angola      Africa  1952  30.015  4232095   3520.6103
## 5  Argentina  Americas  1952  62.485 17876956   5911.3151
## 6  Australia  Oceania   1952  69.120  8691212  10039.5956
## 7    Austria      Europe  1952  66.800  6927772   6137.0765
## 8    Bahrain      Asia   1952  50.939  120447    9867.0848
```

MUTATE

`mutate` allows you to create new variables:

```
mutate(gapminder, gdp = pop * gdpPercap)
```

```
## # A tibble: 1,704 x 7
```

```
##       country continent  year lifeExp      pop gdpPercap      gdp
##       <fctr>      <fctr> <int>   <dbl>    <int>    <dbl>    <dbl>
## 1  Afghanistan      Asia  1952  28.801  8425333  779.4453 6567086330
## 2  Afghanistan      Asia  1957  30.332  9240934  820.8530 7585448670
## 3  Afghanistan      Asia  1962  31.997 10267083  853.1007 8758855797
## 4  Afghanistan      Asia  1967  34.020 11537966  836.1971 9648014150
## 5  Afghanistan      Asia  1972  36.088 13079460  739.9811 9678553274
## 6  Afghanistan      Asia  1977  38.438 14880372  786.1134 11697659231
## 7  Afghanistan      Asia  1982  39.854 12881816  878.0114 12508563401
```

MUTATE

We can create multiple variables at once:

```
mutate(gapminder,  
      gdp = pop * gdpPercap,  
      gdp_in_billions = gdp / 1000000)
```

```
## # A tibble: 1,704 x 8
```

```
##       country continent  year lifeExp      pop gdpPercap      gdp  
##       <fctr>      <fctr> <int>   <dbl>    <int>    <dbl>    <dbl>  
## 1  Afghanistan      Asia  1952  28.801  8425333  779.4453 6567086330  
## 2  Afghanistan      Asia  1957  30.332  9240934  820.8530 7585448670  
## 3  Afghanistan      Asia  1962  31.997 10267083  853.1007 8758855797  
## 4  Afghanistan      Asia  1967  34.020 11537966  836.1971 9648014150  
## 5  Afghanistan      Asia  1972  36.088 13070460  730.0811 9678553274
```

`summarize` (or `summarise` if you prefer) creates summary statistics:

```
summarize(gapminder, mean_life = mean(lifeExp))
```

```
## # A tibble: 1 x 1
##   mean_life
##       <dbl>
## 1  59.47444
```

GROUP_BY

`group_by` allows us to perform operations by groups:

```
by_year <- group_by(gapminder, year)
summarize(by_year, mean_life = mean(lifeExp))
```

```
## # A tibble: 12 x 2
##   year mean_life
##   <int>     <dbl>
## 1  1952  49.05762
## 2  1957  51.50740
## 3  1962  53.60925
## 4  1967  55.67829
## 5  1972  57.64739
## 6  1977  59.57016
```

PIPING

The pipe operator `%>%` pipes the output of the left side to the first argument of the right side:

```
gapminder %>%  
  group_by(continent, year) %>%  
  summarize(mean_life = mean(lifeExp),  
            n = n())
```

```
## Source: local data frame [60 x 4]  
## Groups: continent [?]  
##  
##   continent  year mean_life    n  
##   <fctr> <int>    <dbl> <int>  
## 1 Africa  1952  39.13550    52
```

YOU TRY!

- What is the mean life expectancy in Europe in 1997?

YOU TRY!

- What is the mean life expectancy in Europe in 1997?
- What is the total population of Asia in 1992?

YOU TRY!

- What is the mean life expectancy in Europe in 1997?
- What is the total population of Asia in 1992?
- Create a plot with year along the x-axis and average life expectancy by continent along the y-axis.

YOU TRY (ANSWERS)

```
gapminder %>%  
  filter(year == 1997, continent == "Europe") %>%  
  summarize(mean_life = mean(lifeExp))
```

```
## # A tibble: 1 x 1  
##   mean_life  
##       <dbl>  
## 1  75.50517
```

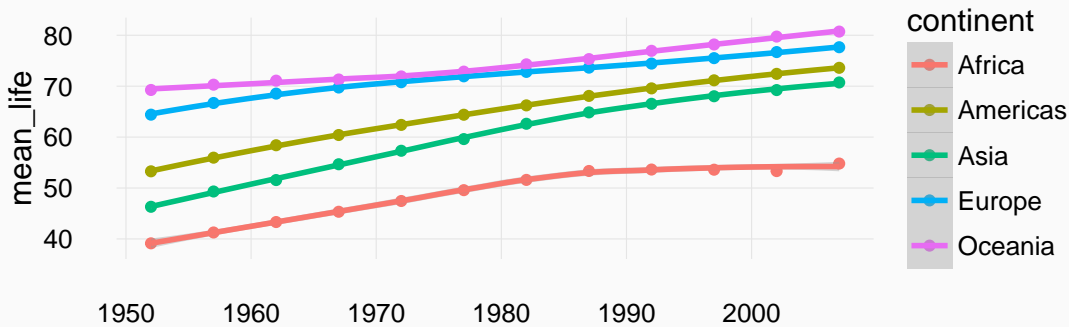
YOU TRY (ANSWERS)

```
gapminder %>%  
  filter(continent == "Asia", year == 1992) %>%  
  summarize(total_pop = sum(as.numeric(pop)))
```

```
## # A tibble: 1 x 1  
##   total_pop  
##   <dbl>  
## 1 3133292191
```

YOU TRY (ANSWERS)

```
gapminder %>%  
  group_by(year, continent) %>%  
  summarize(mean_life = mean(lifeExp)) %>%  
  ggplot(aes(year, mean_life, color = continent)) +  
  geom_point() + geom_smooth()
```



SUMMARIZE ALL

We can use `summarize_all` to summarize multiple variables:

```
gapminder %>%  
  group_by(year) %>%  
  summarize_all(mean)  
  
## Warning in mean.default(structure(1:142, .Label = c("Afghanistan",  
## "Albania", : argument is not numeric or logical: returning NA  
  
## Warning in mean.default(structure(1:142, .Label = c("Afghanistan",  
## "Albania", : argument is not numeric or logical: returning NA  
  
## Warning in mean.default(structure(1:142, .Label = c("Afghanistan",  
## "Albania" : argument is not numeric or logical: returning NA
```

SUMMARIZE IF

`summarize_if` allows us to do conditional summaries:

```
gapminder %>%  
  group_by(year) %>%  
  summarize_if(is.numeric, mean)
```

```
## # A tibble: 12 x 4  
##   year  lifeExp      pop gdpPercap  
##   <int>   <dbl>   <dbl>   <dbl>  
## 1  1952  49.05762 16950402  3725.276  
## 2  1957  51.50740 18763413  4299.408  
## 3  1962  53.60925 20421007  4725.812  
## 4  1967  55.67829 22658298  5483.653  
## 5  1972  57.64739 25189980  6770.083
```