Dealing with Data in R

How to Use dplyr

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Data transformation

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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    - What to do with the data frame
    - Result is always a data frame

FILTER

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```
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 29804.346
```

Comparisons

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- Equal `==`
- Not equal `!=`
- Greater than `>` (or equal to `>=`)
- 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

AND, OR, AND %IN%

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

```
## Error in filter_impl(.data, quo): Evaluation error: operations are pos
```

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  978.0114 12598563401
```

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 13079460  739.9811  9678553274
```

Summarize

`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` 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())
```

```
## # A tibble: 60 x 4
## # Groups:   continent [?]
##    continent  year mean_life     n
##       <fctr> <int>     <dbl> <int>
##  1    Africa  1952  39.13550    52
##  2    Africa  1957  41.26635    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)

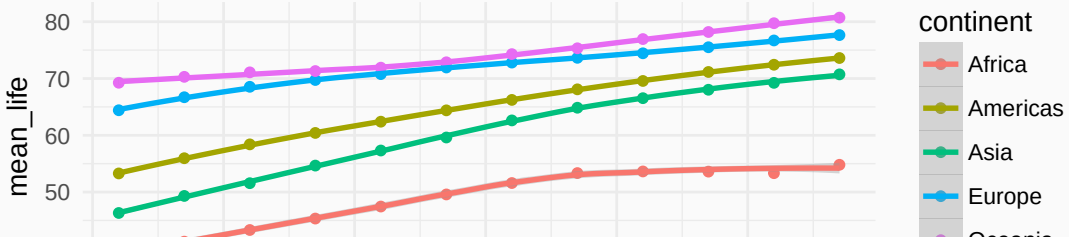
```
gapminder %>%
  filter(continent == "Asia", year == 1992) %>%
  summarize(total_pop = sum(as.numeric(pop)))
```

```
## # 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()
```

```
## `geom_smooth()` using method = 'loess'
```



Summarize all

We can use `summarize_all` to summarize multiple variables:

```
gapminder %>%
  group_by(year) %>%
  summarize_all(mean)
```

```
## Warning in mean.default(country): argument is not numeric or logical:
## returning NA

## Warning in mean.default(country): argument is not numeric or logical:
## returning NA

## Warning in mean.default(country): 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
```