

Chapter_14

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```
library(tidyverse)

## -- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
## v dplyr      1.1.2      v readr      2.1.4
## v forcats    1.0.0      v stringr   1.5.0
## v ggplot2     3.4.2      v tibble    3.2.1
## v lubridate   1.9.2      v tidyr     1.3.0
## v purrr       1.0.1
## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()     masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors

library(readr)
library(RSQLite)

## Warning: package 'RSQLite' was built under R version 4.3.2

library(DBI)          # DataBase Interface Package
library(dbplyr)        # dplyr with databases!

##
## Attaching package: 'dbplyr'
##
## The following objects are masked from 'package:dplyr':
##
##   ident, sql

library(ggplot2)
library(cowplot)

## Warning: package 'cowplot' was built under R version 4.3.2

##
## Attaching package: 'cowplot'
##
## The following object is masked from 'package:lubridate':
##
##   stamp

library(ggrepel)

a.

library(faraway)
data(infmort)
```

```
head(infmort)
```

```
##           region income mortality      oil
## Australia      Asia   3426      26.7 no oil exports
## Austria        Europe 3350      23.7 no oil exports
## Belgium        Europe 3346      17.0 no oil exports
## Canada         Americas 4751      16.8 no oil exports
## Denmark        Europe 5029      13.5 no oil exports
## Finland        Europe 3312      10.1 no oil exports
```

```
mytable <- infmort %>% mutate(country = rownames(infmort))
mytable
```

```
##           region income mortality      oil
## Australia      Asia   3426      26.7 no oil exports
## Austria        Europe 3350      23.7 no oil exports
## Belgium        Europe 3346      17.0 no oil exports
## Canada         Americas 4751      16.8 no oil exports
## Denmark        Europe 5029      13.5 no oil exports
## Finland        Europe 3312      10.1 no oil exports
## France         Europe 3403      12.9 no oil exports
## West_Germany   Europe 5040      20.4 no oil exports
## Ireland        Europe 2009      17.8 no oil exports
## Italy          Europe 2298      25.7 no oil exports
## Japan          Europe 3292      11.7 no oil exports
## Netherlands    Europe 4103      11.6 no oil exports
## New_Zealand    Asia   3723      16.2 no oil exports
## Norway         Europe 4102      11.3 no oil exports
## Portugal       Europe  956      44.8 no oil exports
## South_Africa   Africa 1000      71.5 no oil exports
## Sweden         Europe 5596       9.6 no oil exports
## Switzerland    Europe 2963      12.8 no oil exports
## Britain        Europe 2503      17.5 no oil exports
## United_States  Americas 5523      17.6 no oil exports
## Algeria        Africa  400      86.3 oil exports
## Ecuador        Americas 250      78.5 oil exports
## Indonesia      Asia   110      125.0 oil exports
## Iran           Asia  1280       NA oil exports
## Iraq           Asia   560      28.1 oil exports
## Libya          Africa 3010     300.0 oil exports
## Nigeria        Africa  220      58.0 oil exports
## Saudi_Arabia   Asia  1530     650.0 oil exports
## Venezuela      Americas 1240     51.7 oil exports
## Argentina      Americas 1191     59.6 no oil exports
## Brazil         Americas  425     170.0 no oil exports
## Chile          Americas  590      78.0 no oil exports
## Colombia       Americas  426     62.8 no oil exports
## Costa_Rica     Americas  725     54.4 no oil exports
## Dominican_Republic Americas  406     48.8 no oil exports
## Greece         Europe 1760     27.8 no oil exports
## Guatemala      Americas  302     79.1 no oil exports
## Israel         Asia  2526     22.1 no oil exports
## Jamaica        Americas  727     26.2 no oil exports
## Lebanon        Asia   631      13.6 no oil exports
```

## Malaysia	Asia	295	32.0	no oil exports
## Mexico	Americas	684	60.9	no oil exports
## Nicaragua	Americas	507	46.0	no oil exports
## Panama	Americas	754	34.1	no oil exports
## Peru	Americas	335	65.1	no oil exports
## Singapore	Asia	1268	20.4	no oil exports
## Spain	Europe	1256	15.1	no oil exports
## Taiwan	Asia	261	19.1	no oil exports
## Trinidad_and_Tobago	Americas	732	26.2	no oil exports
## Tunisia	Africa	434	76.3	no oil exports
## Uruguay	Americas	799	40.4	no oil exports
## Yugoslavia	Europe	406	43.3	no oil exports
## Zambia	Africa	310	259.0	no oil exports
## Bolivia	Americas	200	60.4	no oil exports
## Cameroon	Africa	100	137.0	no oil exports
## Congo	Africa	281	180.0	no oil exports
## Egypt	Africa	210	114.0	no oil exports
## El_Salvador	Americas	319	58.2	no oil exports
## Ghana	Africa	217	63.7	no oil exports
## Honduras	Americas	284	39.3	no oil exports
## Ivory_Coast	Africa	387	138.0	no oil exports
## Jordan	Asia	334	21.3	no oil exports
## South_Korea	Asia	344	58.0	no oil exports
## Liberia	Africa	197	159.2	no oil exports
## Morocco	Africa	279	149.0	no oil exports
## Papua_New_Guinea	Asia	477	10.2	no oil exports
## Paraguay	Americas	347	38.6	no oil exports
## Philippines	Asia	230	67.9	no oil exports
## Syria	Asia	334	21.7	no oil exports
## Thailand	Asia	210	27.0	no oil exports
## Turkey	Asia	435	153.0	no oil exports
## South_Vietnam	Asia	130	100.0	no oil exports
## Afganistan	Asia	75	400.0	no oil exports
## Bangladesh	Asia	100	124.3	no oil exports
## Burma	Asia	73	200.0	no oil exports
## Burundi	Africa	68	150.0	no oil exports
## Cambodia	Asia	123	100.0	no oil exports
## Central_African_Rep	Africa	122	190.0	no oil exports
## Chad	Africa	70	160.0	no oil exports
## Dahomey	Africa	81	109.6	no oil exports
## Ethiopia	Africa	79	84.2	no oil exports
## Guinea	Africa	79	216.0	no oil exports
## Haiti	Americas	100	NA	no oil exports
## India	Asia	93	60.6	no oil exports
## Kenya	Africa	169	55.0	no oil exports
## Laos	Asia	71	NA	no oil exports
## Madagascar	Africa	120	102.0	no oil exports
## Malawi	Africa	130	148.3	no oil exports
## Mali	Africa	50	120.0	no oil exports
## Mauritania	Africa	174	187.0	no oil exports
## Nepal	Asia	90	NA	no oil exports
## Niger	Africa	70	200.0	no oil exports
## Pakistan	Asia	102	124.3	no oil exports
## Rwanda	Africa	61	132.9	no oil exports

## Sierra_Leone	Africa	148	170.0	no oil exports
## Somalia	Africa	85	158.0	no oil exports
## Sri_Lanka	Asia	162	45.1	no oil exports
## Sudan	Africa	125	129.4	no oil exports
## Tanzania	Africa	120	162.5	no oil exports
## Togo	Africa	160	127.0	no oil exports
## Uganda	Africa	134	160.0	no oil exports
## Upper_Volta	Africa	82	180.0	no oil exports
## Southern_Yemen	Asia	96	80.0	no oil exports
## Yemen	Asia	77	50.0	no oil exports
## Zaire	Africa	118	104.0	no oil exports
##	country			
## Australia	Australia			
## Austria	Austria			
## Belgium	Belgium			
## Canada	Canada			
## Denmark	Denmark			
## Finland	Finland			
## France	France			
## West_Germany	West_Germany			
## Ireland	Ireland			
## Italy	Italy			
## Japan	Japan			
## Netherlands	Netherlands			
## New_Zealand	New_Zealand			
## Norway	Norway			
## Portugal	Portugal			
## South_Africa	South_Africa			
## Sweden	Sweden			
## Switzerland	Switzerland			
## Britain	Britain			
## United_States	United_States			
## Algeria	Algeria			
## Ecuador	Ecuador			
## Indonesia	Indonesia			
## Iran	Iran			
## Iraq	Iraq			
## Libya	Libya			
## Nigeria	Nigeria			
## Saudi_Arabia	Saudi_Arabia			
## Venezuela	Venezuela			
## Argentina	Argentina			
## Brazil	Brazil			
## Chile	Chile			
## Colombia	Colombia			
## Costa_Rica	Costa_Rica			
## Dominican_Republic	Dominican_Republic			
## Greece	Greece			
## Guatemala	Guatemala			
## Israel	Israel			
## Jamaica	Jamaica			
## Lebanon	Lebanon			
## Malaysia	Malaysia			
## Mexico	Mexico			

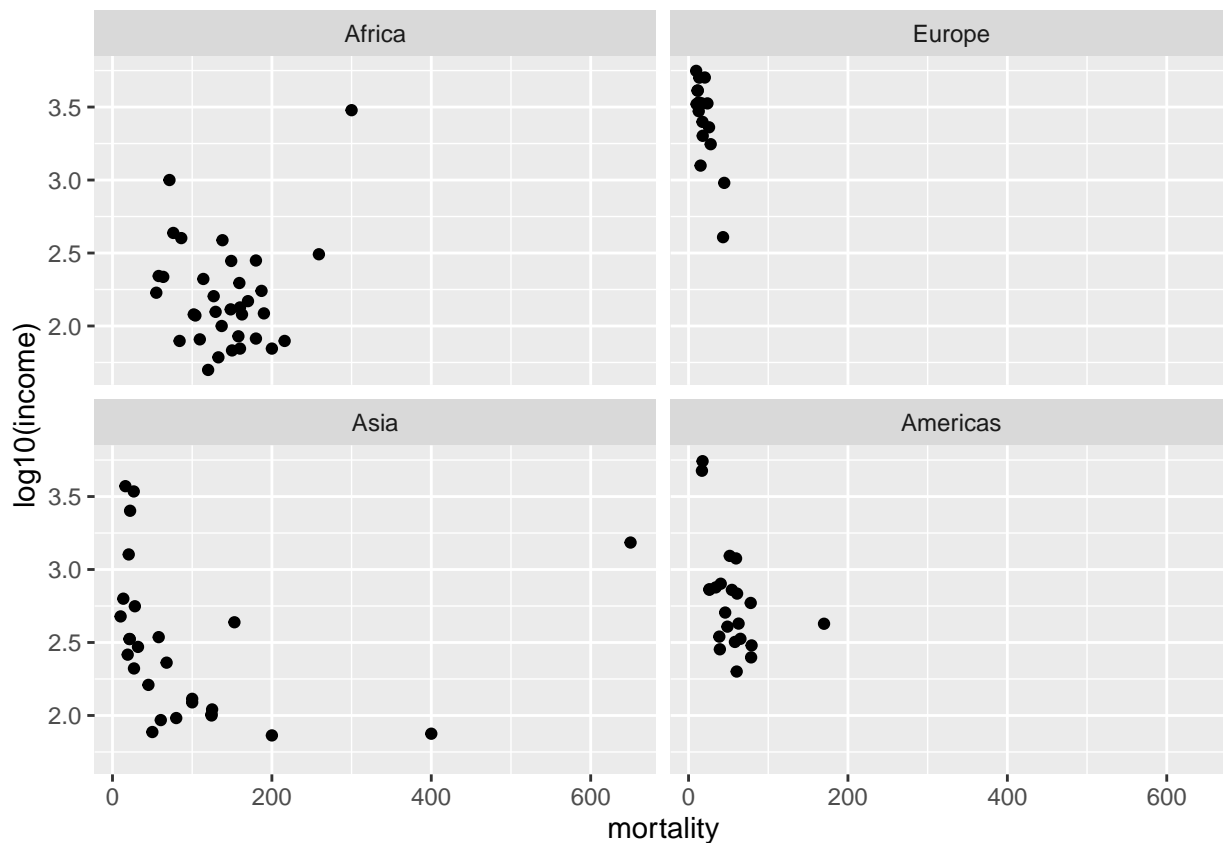
## Nicaragua	Nicaragua
## Panama	Panama
## Peru	Peru
## Singapore	Singapore
## Spain	Spain
## Taiwan	Taiwan
## Trinidad_and_Tobago	Trinidad_and_Tobago
## Tunisia	Tunisia
## Uruguay	Uruguay
## Yugoslavia	Yugoslavia
## Zambia	Zambia
## Bolivia	Bolivia
## Cameroon	Cameroon
## Congo	Congo
## Egypt	Egypt
## El_Salvador	El_Salvador
## Ghana	Ghana
## Honduras	Honduras
## Ivory_Coast	Ivory_Coast
## Jordan	Jordan
## South_Korea	South_Korea
## Liberia	Liberia
## Moroco	Moroco
## Papua_New_Guinea	Papua_New_Guinea
## Paraguay	Paraguay
## Philippines	Philippines
## Syria	Syria
## Thailand	Thailand
## Turkey	Turkey
## South_Vietnam	South_Vietnam
## Afganistan	Afganistan
## Bangladesh	Bangladesh
## Burma	Burma
## Burundi	Burundi
## Cambodia	Cambodia
## Central_African_Rep	Central_African_Rep
## Chad	Chad
## Dahomey	Dahomey
## Ethiopia	Ethiopia
## Guinea	Guinea
## Haiti	Haiti
## India	India
## Kenya	Kenya
## Laos	Laos
## Madagascar	Madagascar
## Malawi	Malawi
## Mali	Mali
## Mauritania	Mauritania
## Nepal	Nepal
## Niger	Niger
## Pakistan	Pakistan
## Rwanda	Rwanda
## Sierra_Leone	Sierra_Leone
## Somalia	Somalia

```
## Sri_Lanka      Sri_Lanka
## Sudan          Sudan
## Tanzania       Tanzania
## Togo           Togo
## Uganda         Uganda
## Upper_Volta    Upper_Volta
## Southern_Yemen Southern_Yemen
## Yemen          Yemen
## Zaire          Zaire
```

b.

```
ggplot(infmort, aes(x=mortality, y=log10(income))) +
  geom_point() +
  facet_wrap( . ~region )
```

```
## Warning: Removed 4 rows containing missing values (`geom_point()`).
```



c.

```
library(cowplot)
cowplot::plot_grid(
  ggplot(infmort, aes(x=income, y=mortality)) +
    geom_point() +
    scale_y_log10(breaks=c(10,100,500),
                  minor=c(1:10,
                          seq(10,100,by=10))) +
  ylab('Income (1000s of dollars)') +
```

```

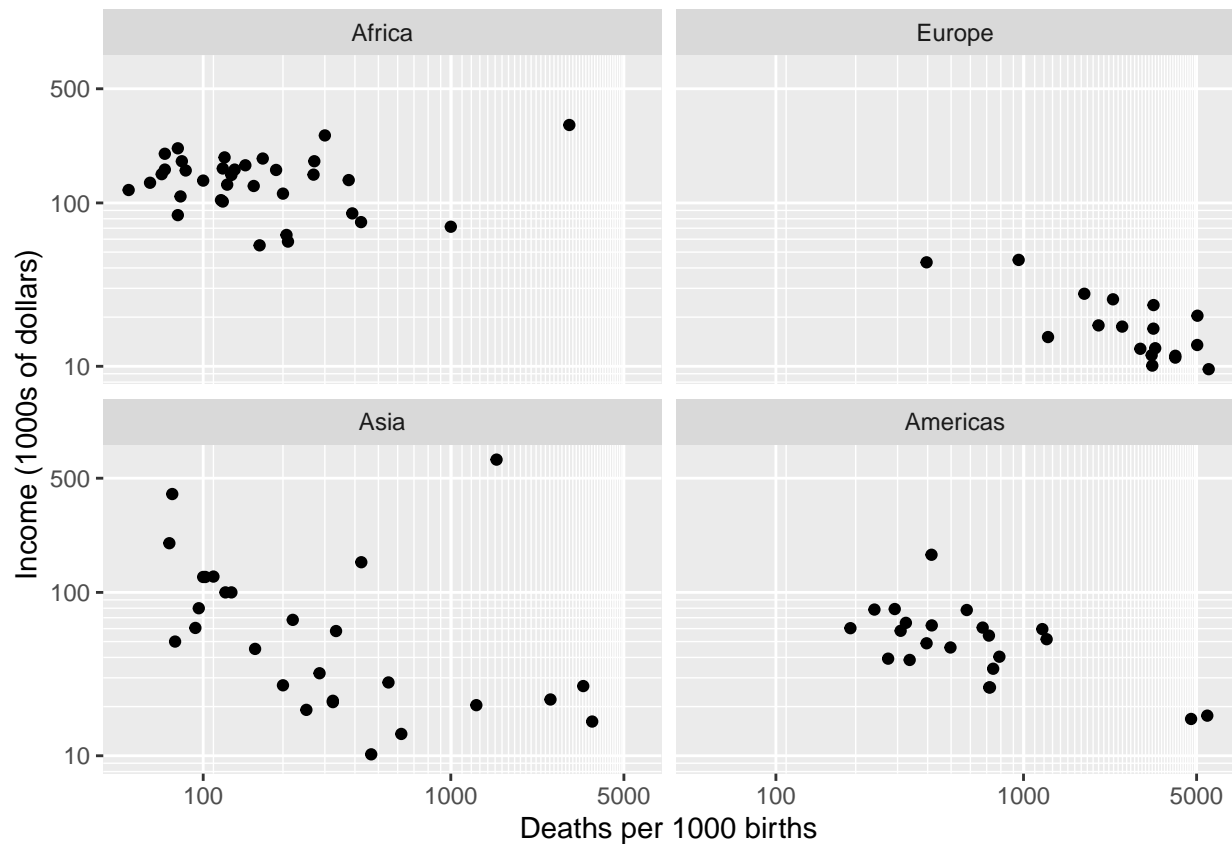
scale_x_log10(breaks=c(1,10,100,1000,5000),
              minor=c(1:10,
seq(10,5000,by=100))) +
xlab('Deaths per 1000 births') +

facet_wrap( . ~region )

)

```

```
## Warning: Removed 4 rows containing missing values (`geom_point()`).
```



- d. The package `ggrepel` contains functions `geom_text_repel()` and `geom_label_repel()` that mimic the basic `geom_text()` and `geom_label()` functions in `ggplot2`, but work to make sure the labels don't overlap. Select 10-15 countries to label and do so using the `geom_text_repel()` function.

```

library(ggrepel)
library(cowplot)

countries <- mytable %>% mutate(country2= ifelse(str_detect(country, "R"),country,NA))
countries

```

```
##           region income mortality      oil
## Australia      Asia   3426    26.7 no oil exports
## Austria        Europe  3350    23.7 no oil exports
## Belgium        Europe  3346    17.0 no oil exports
```

## Canada	Americas	4751	16.8	no oil exports
## Denmark	Europe	5029	13.5	no oil exports
## Finland	Europe	3312	10.1	no oil exports
## France	Europe	3403	12.9	no oil exports
## West_Germany	Europe	5040	20.4	no oil exports
## Ireland	Europe	2009	17.8	no oil exports
## Italy	Europe	2298	25.7	no oil exports
## Japan	Europe	3292	11.7	no oil exports
## Netherlands	Europe	4103	11.6	no oil exports
## New_Zealand	Asia	3723	16.2	no oil exports
## Norway	Europe	4102	11.3	no oil exports
## Portugal	Europe	956	44.8	no oil exports
## South_Africa	Africa	1000	71.5	no oil exports
## Sweden	Europe	5596	9.6	no oil exports
## Switzerland	Europe	2963	12.8	no oil exports
## Britain	Europe	2503	17.5	no oil exports
## United_States	Americas	5523	17.6	no oil exports
## Algeria	Africa	400	86.3	oil exports
## Ecuador	Americas	250	78.5	oil exports
## Indonesia	Asia	110	125.0	oil exports
## Iran	Asia	1280	NA	oil exports
## Iraq	Asia	560	28.1	oil exports
## Libya	Africa	3010	300.0	oil exports
## Nigeria	Africa	220	58.0	oil exports
## Saudi_Arabia	Asia	1530	650.0	oil exports
## Venezuela	Americas	1240	51.7	oil exports
## Argentina	Americas	1191	59.6	no oil exports
## Brazil	Americas	425	170.0	no oil exports
## Chile	Americas	590	78.0	no oil exports
## Colombia	Americas	426	62.8	no oil exports
## Costa_Rica	Americas	725	54.4	no oil exports
## Dominican_Republic	Americas	406	48.8	no oil exports
## Greece	Europe	1760	27.8	no oil exports
## Guatemala	Americas	302	79.1	no oil exports
## Israel	Asia	2526	22.1	no oil exports
## Jamaica	Americas	727	26.2	no oil exports
## Lebanon	Asia	631	13.6	no oil exports
## Malaysia	Asia	295	32.0	no oil exports
## Mexico	Americas	684	60.9	no oil exports
## Nicaragua	Americas	507	46.0	no oil exports
## Panama	Americas	754	34.1	no oil exports
## Peru	Americas	335	65.1	no oil exports
## Singapore	Asia	1268	20.4	no oil exports
## Spain	Europe	1256	15.1	no oil exports
## Taiwan	Asia	261	19.1	no oil exports
## Trinidad_and_Tobago	Americas	732	26.2	no oil exports
## Tunisia	Africa	434	76.3	no oil exports
## Uruguay	Americas	799	40.4	no oil exports
## Yugoslavia	Europe	406	43.3	no oil exports
## Zambia	Africa	310	259.0	no oil exports
## Bolivia	Americas	200	60.4	no oil exports
## Cameroon	Africa	100	137.0	no oil exports
## Congo	Africa	281	180.0	no oil exports
## Egypt	Africa	210	114.0	no oil exports

## El_Salvador	Americas	319	58.2	no oil exports
## Ghana	Africa	217	63.7	no oil exports
## Honduras	Americas	284	39.3	no oil exports
## Ivory_Coast	Africa	387	138.0	no oil exports
## Jordan	Asia	334	21.3	no oil exports
## South_Korea	Asia	344	58.0	no oil exports
## Liberia	Africa	197	159.2	no oil exports
## Morocco	Africa	279	149.0	no oil exports
## Papua_New_Guinea	Asia	477	10.2	no oil exports
## Paraguay	Americas	347	38.6	no oil exports
## Philippines	Asia	230	67.9	no oil exports
## Syria	Asia	334	21.7	no oil exports
## Thailand	Asia	210	27.0	no oil exports
## Turkey	Asia	435	153.0	no oil exports
## South_Vietnam	Asia	130	100.0	no oil exports
## Afganistan	Asia	75	400.0	no oil exports
## Bangladesh	Asia	100	124.3	no oil exports
## Burma	Asia	73	200.0	no oil exports
## Burundi	Africa	68	150.0	no oil exports
## Cambodia	Asia	123	100.0	no oil exports
## Central_African_Rep	Africa	122	190.0	no oil exports
## Chad	Africa	70	160.0	no oil exports
## Dahomey	Africa	81	109.6	no oil exports
## Ethiopia	Africa	79	84.2	no oil exports
## Guinea	Africa	79	216.0	no oil exports
## Haiti	Americas	100	NA	no oil exports
## India	Asia	93	60.6	no oil exports
## Kenya	Africa	169	55.0	no oil exports
## Laos	Asia	71	NA	no oil exports
## Madagascar	Africa	120	102.0	no oil exports
## Malawi	Africa	130	148.3	no oil exports
## Mali	Africa	50	120.0	no oil exports
## Mauritania	Africa	174	187.0	no oil exports
## Nepal	Asia	90	NA	no oil exports
## Niger	Africa	70	200.0	no oil exports
## Pakistan	Asia	102	124.3	no oil exports
## Rwanda	Africa	61	132.9	no oil exports
## Sierra_Leone	Africa	148	170.0	no oil exports
## Somalia	Africa	85	158.0	no oil exports
## Sri_Lanka	Asia	162	45.1	no oil exports
## Sudan	Africa	125	129.4	no oil exports
## Tanzania	Africa	120	162.5	no oil exports
## Togo	Africa	160	127.0	no oil exports
## Uganda	Africa	134	160.0	no oil exports
## Upper_Volta	Africa	82	180.0	no oil exports
## Southern_Yemen	Asia	96	80.0	no oil exports
## Yemen	Asia	77	50.0	no oil exports
## Zaire	Africa	118	104.0	no oil exports
##		country		country2
## Australia	Australia			<NA>
## Austria	Austria			<NA>
## Belgium	Belgium			<NA>
## Canada	Canada			<NA>
## Denmark	Denmark			<NA>

## Finland	Finland	<NA>
## France	France	<NA>
## West_Germany	West_Germany	<NA>
## Ireland	Ireland	<NA>
## Italy	Italy	<NA>
## Japan	Japan	<NA>
## Netherlands	Netherlands	<NA>
## New_Zealand	New_Zealand	<NA>
## Norway	Norway	<NA>
## Portugal	Portugal	<NA>
## South_Africa	South_Africa	<NA>
## Sweden	Sweden	<NA>
## Switzerland	Switzerland	<NA>
## Britain	Britain	<NA>
## United_States	United_States	<NA>
## Algeria	Algeria	<NA>
## Ecuador	Ecuador	<NA>
## Indonesia	Indonesia	<NA>
## Iran	Iran	<NA>
## Iraq	Iraq	<NA>
## Libya	Libya	<NA>
## Nigeria	Nigeria	<NA>
## Saudi_Arabia	Saudi_Arabia	<NA>
## Venezuela	Venezuela	<NA>
## Argentina	Argentina	<NA>
## Brazil	Brazil	<NA>
## Chile	Chile	<NA>
## Colombia	Colombia	<NA>
## Costa_Rica	Costa_Rica	Costa_Rica
## Dominican_Republic	Dominican_Republic	Dominican_Republic
## Greece	Greece	<NA>
## Guatemala	Guatemala	<NA>
## Israel	Israel	<NA>
## Jamaica	Jamaica	<NA>
## Lebanon	Lebanon	<NA>
## Malaysia	Malaysia	<NA>
## Mexico	Mexico	<NA>
## Nicaragua	Nicaragua	<NA>
## Panama	Panama	<NA>
## Peru	Peru	<NA>
## Singapore	Singapore	<NA>
## Spain	Spain	<NA>
## Taiwan	Taiwan	<NA>
## Trinidad_and_Tobago	Trinidad_and_Tobago	<NA>
## Tunisia	Tunisia	<NA>
## Uruguay	Uruguay	<NA>
## Yugoslavia	Yugoslavia	<NA>
## Zambia	Zambia	<NA>
## Bolivia	Bolivia	<NA>
## Cameroon	Cameroon	<NA>
## Congo	Congo	<NA>
## Egypt	Egypt	<NA>
## El_Salvador	El_Salvador	<NA>
## Ghana	Ghana	<NA>

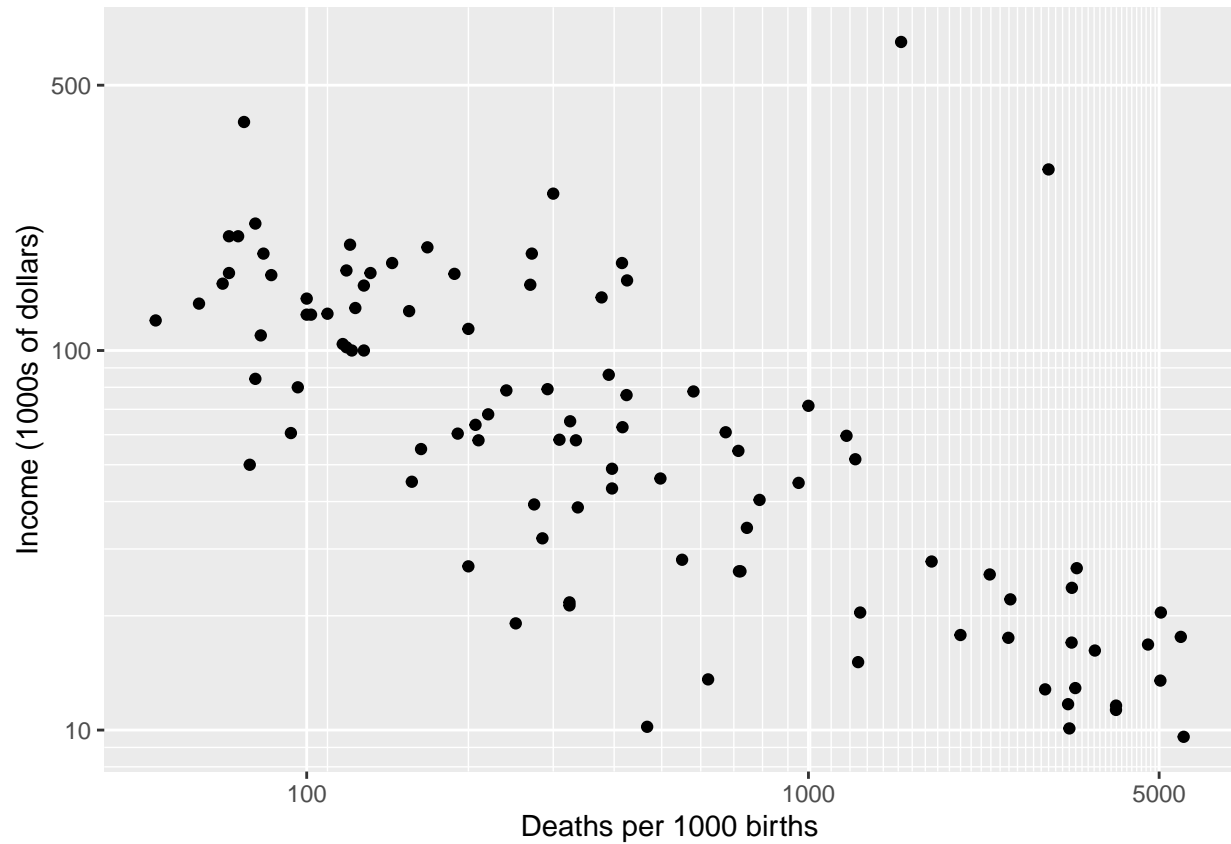
## Honduras	Honduras	<NA>
## Ivory_Coast	Ivory_Coast	<NA>
## Jordan	Jordan	<NA>
## South_Korea	South_Korea	<NA>
## Liberia	Liberia	<NA>
## Moroco	Moroco	<NA>
## Papua_New_Guinea	Papua_New_Guinea	<NA>
## Paraguay	Paraguay	<NA>
## Philippines	Philippines	<NA>
## Syria	Syria	<NA>
## Thailand	Thailand	<NA>
## Turkey	Turkey	<NA>
## South_Vietnam	South_Vietnam	<NA>
## Afganistan	Afganistan	<NA>
## Bangladesh	Bangladesh	<NA>
## Burma	Burma	<NA>
## Burundi	Burundi	<NA>
## Cambodia	Cambodia	<NA>
## Central_African_Rep	Central_African_Rep	Central_African_Rep
## Chad	Chad	<NA>
## Dahomey	Dahomey	<NA>
## Ethiopia	Ethiopia	<NA>
## Guinea	Guinea	<NA>
## Haiti	Haiti	<NA>
## India	India	<NA>
## Kenya	Kenya	<NA>
## Laos	Laos	<NA>
## Madagascar	Madagascar	<NA>
## Malawi	Malawi	<NA>
## Mali	Mali	<NA>
## Mauritania	Mauritania	<NA>
## Nepal	Nepal	<NA>
## Niger	Niger	<NA>
## Pakistan	Pakistan	<NA>
## Rwanda	Rwanda	Rwanda
## Sierra_Leone	Sierra_Leone	<NA>
## Somalia	Somalia	<NA>
## Sri_Lanka	Sri_Lanka	<NA>
## Sudan	Sudan	<NA>
## Tanzania	Tanzania	<NA>
## Togo	Togo	<NA>
## Uganda	Uganda	<NA>
## Upper_Volta	Upper_Volta	<NA>
## Southern_Yemen	Southern_Yemen	<NA>
## Yemen	Yemen	<NA>
## Zaire	Zaire	<NA>

```
plot5 <- ggplot(countries, aes(x=income, y=mortality, label=country2) ) +
  geom_point() +
  scale_y_log10(breaks=c(10,100,500),
               minor=c(1:10,
                      seq(10,100,by=10))) +
  ylab('Income (1000s of dollars)') +
```

```
scale_x_log10(breaks=c(1,10,100,1000,5000),
              minor=c(1:10,
seq(10,5000,by=100))) +
xlab('Deaths per 1000 births')
```

plot5

```
## Warning: Removed 4 rows containing missing values (`geom_point()`).
```

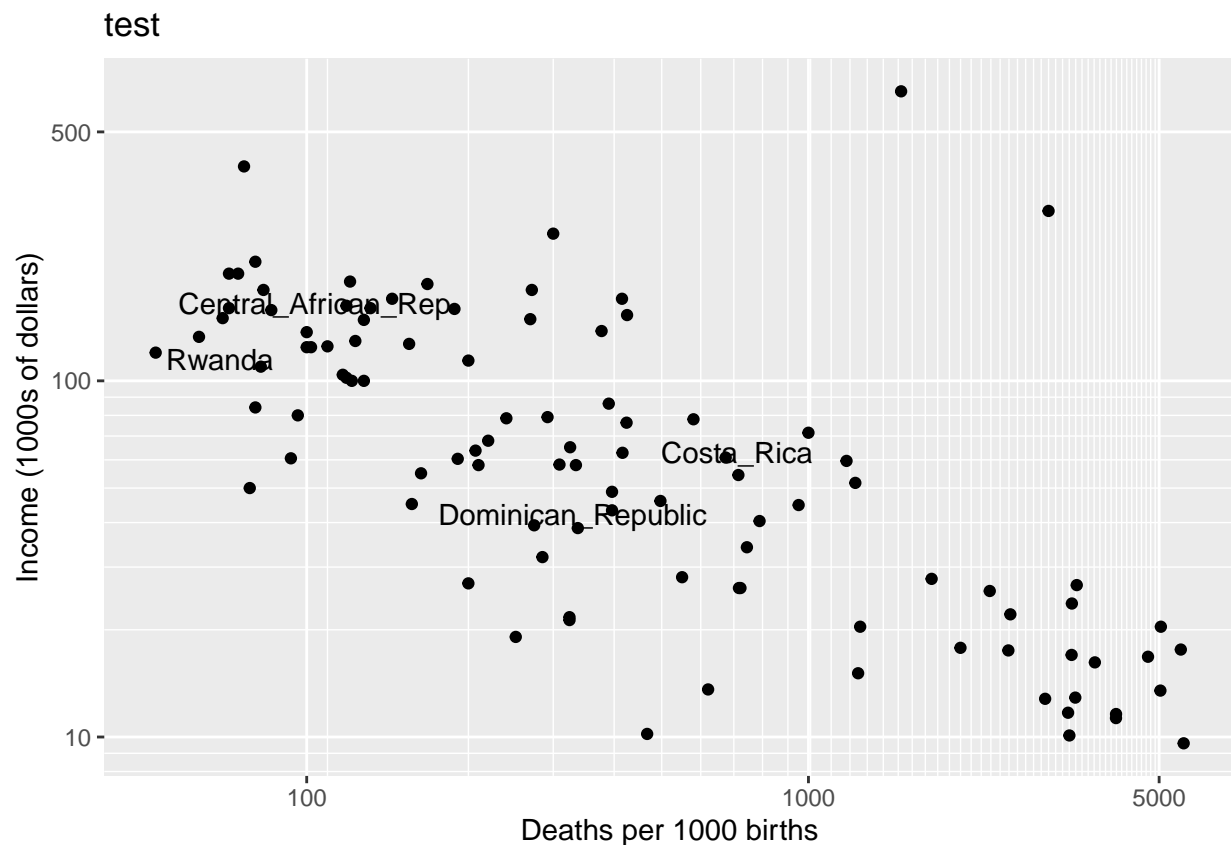


```
plot6 <- plot5 + geom_text_repel() + labs(title='test')
```

plot6

```
## Warning: Removed 4 rows containing missing values (`geom_point()`).
```

```
## Warning: Removed 101 rows containing missing values (`geom_text_repel()`).
```



```
library(faraway)
data(infmort)
head(infmort)
```

```
##           region income mortality      oil
## Australia      Asia   3426    26.7 no oil exports
## Austria        Europe  3350    23.7 no oil exports
## Belgium        Europe  3346    17.0 no oil exports
## Canada         Americas 4751    16.8 no oil exports
## Denmark        Europe  5029    13.5 no oil exports
## Finland        Europe  3312    10.1 no oil exports
```

```
library(datasets)
data(trees)
```

```
model <- lm( trees$Volume ~ trees$Height)
```

```
summary(model)
```

```
##
## Call:
## lm(formula = trees$Volume ~ trees$Height)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
```

```
## -21.274 -9.894 -2.894 12.068 29.852
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -87.1236    29.2731  -2.976 0.005835 **
## trees$Height   1.5433     0.3839   4.021 0.000378 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.4 on 29 degrees of freedom
## Multiple R-squared:  0.3579, Adjusted R-squared:  0.3358
## F-statistic: 16.16 on 1 and 29 DF,  p-value: 0.0003784
```

```
treeplot <- trees %>% ggplot(aes(x=Height, y=Volume, label=Girth) ) +
  geom_point()
```

treeplot

