Categorical Variables (Chapter 4)

Prof. Joyce Robbins

Numeric data

```
## 'data.frame':    15 obs. of  20 variables:
##  $ a1 : num  18.6 37.6 71.6 94.2 100.2 ...
##  $ a2 : num  17 38.2 67.8 106.8 64.2 ...
##  $ a3 : num  19 36.2 90.4 110.9 83.4 ...
##  $ a4 : num  6 48.6 77 115.5 94.1 ...
##  $ a5 : num  15.8 43.6 81.6 133 87.6 ...
##  $ a6 : num  0 22.8 36.6 111.2 54.8 ...
##  $ a7 : num  6.2 31 62 101.5 66.8 ...
##  $ a8 : num  5 30.2 31.1 89.7 53.5 ...
##  $ a9 : num  7.2 27 65 124.1 104.9 ...
##  $ a10: num  0 25.8 60.8 69.5 81.9 ...
##  $ a11: num  8 19.4 60.2 102.7 56.5 ...
##  $ a12: num  15 38 71.4 106.9 67.4 ...
##  $ a13: num  2.8 35.8 66.6 121.5 67.7 ...
##  $ a14: num  4.4 35.4 48 120.7 41 ...
##  $ a15: num  6.6 34.8 52 100.6 78 ...
##  $ a16: num  4 28.6 34.1 101.5 40.1 ...
##  $ a17: num  2.4 41.2 30 116.4 11.2 ...
##  $ a18: num  9.6 24.4 54 103.9 67.4 ...
##  $ a19: num  0 33.8 47.6 111.7 79.7 ...
##  $ a20: num  2.2 31.2 57.6 127.7 65.5 ...
```

Categorical data

```
## Classes 'tbl_df', 'tbl' and 'data.frame':    1373 obs. of  12 variables:
##  $ respondent_id   : num  3308895255 3308891308 3308891135 3308879091 3308871671 ...
##  $ knowledge       : Ord.factor w/ 4 levels "Novice"<"Intermediate"<..: 2 1 2 1 1 3 1 3 1 1 ...
##  $ interest        : Ord.factor w/ 4 levels "Not at all"<"Not much"<..: 3 3 4 2 2 4 3 4 2 3 ...
##  $ gender          : chr  "Male" "Male" "Male" "Male" ...
##  $ age             : Factor w/ 4 levels "18-29","30-44",..: 1 1 2 3 2 2 3 3 2 NA ...
##  $ household_income: Factor w/ 5 levels "$0 - $24,999",..: 4 4 3 1 2 3 NA 1 3 NA ...
##  $ education       : Ord.factor w/ 5 levels "Less than high school degree"<..: 1 3 5 1 2 5 2 3 3
NA ...
##  $ location        : chr  "West South Central" "West South Central" "Pacific" "New England" ...
##  $ algeria         : chr  "N/A" "N/A" "3" "N/A" ...
##  $ argentina       : chr  "3" "N/A" "4" "3" ...
##  $ australia       : chr  "5" "3" "N/A" "N/A" ...
##  $ belgium         : chr  "4" "3" "3" "3" ...
```

Warnings

- words are hard to work with!
- not a lot of options (esp. for 1 dimension): bar plot, Cleveland dot plot
- data cleaning takes more time
- main choices: *which* categories to plot, *order* of categories

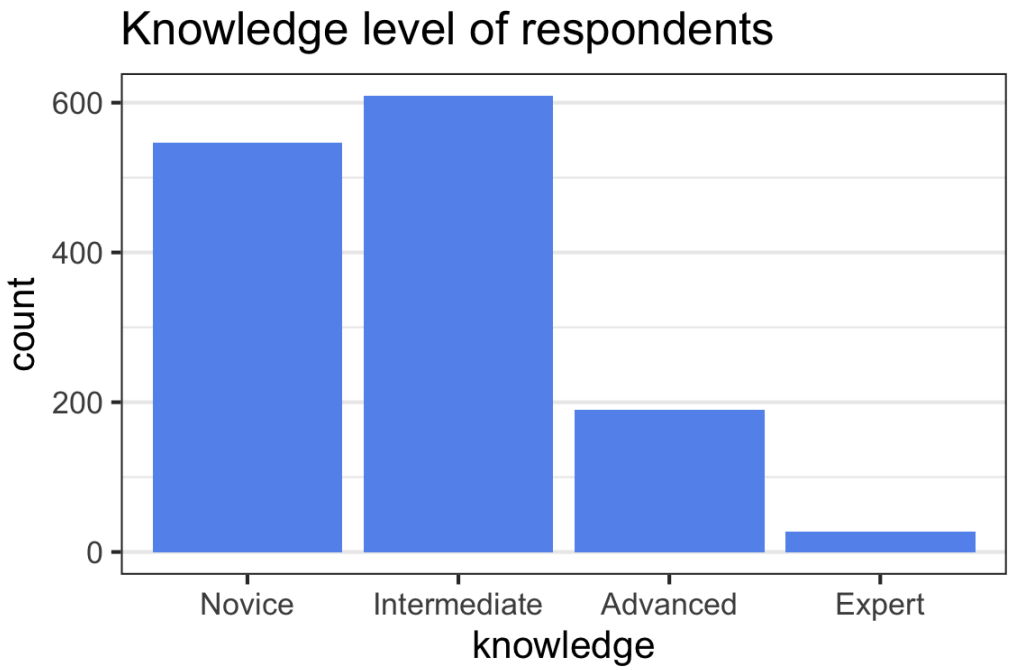
Types of data

- nominal – no fixed category order
- ordinal – fixed category order
- (“real”) discrete, small # of possibilities
- Not always clearcut: nominal vs. ordinal, ordinal vs. discrete, and…
- Sometimes numbers = nominal, not discrete

Ordinal data

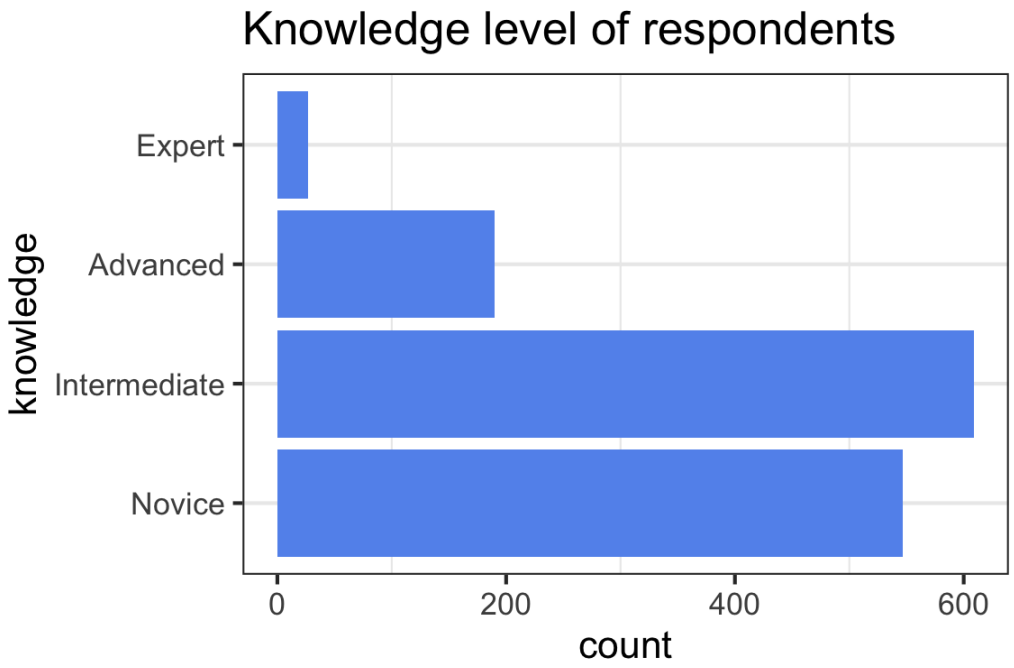
Sort in logical order of the categories (left to right)

ORDERING IS VERY IMPORTANT FOR ALL GRAPHS



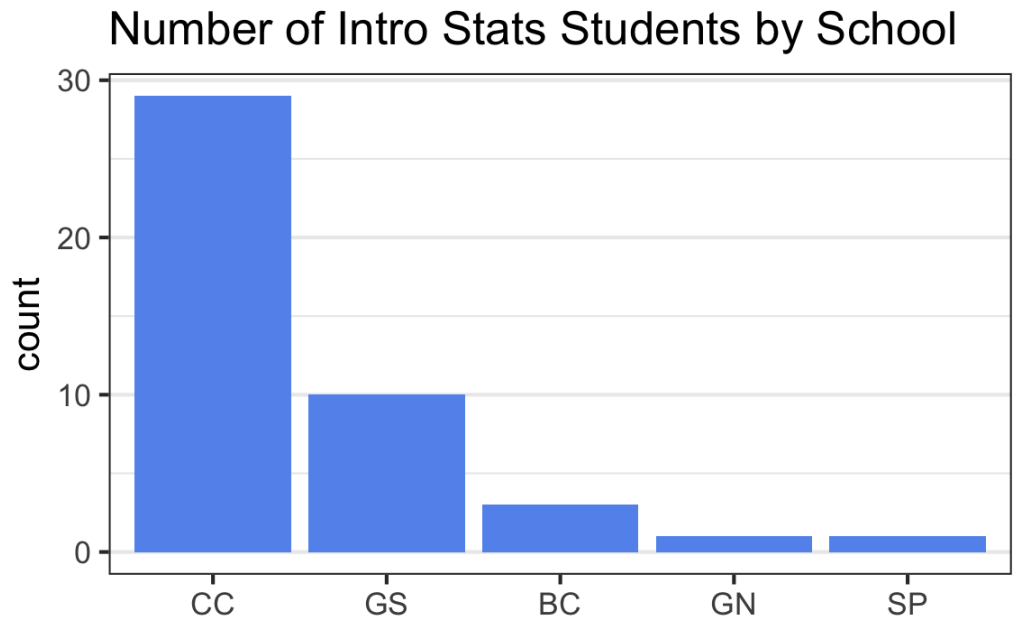
Ordinal data

Sort in logical order of the categories (starting at bottom OR top)



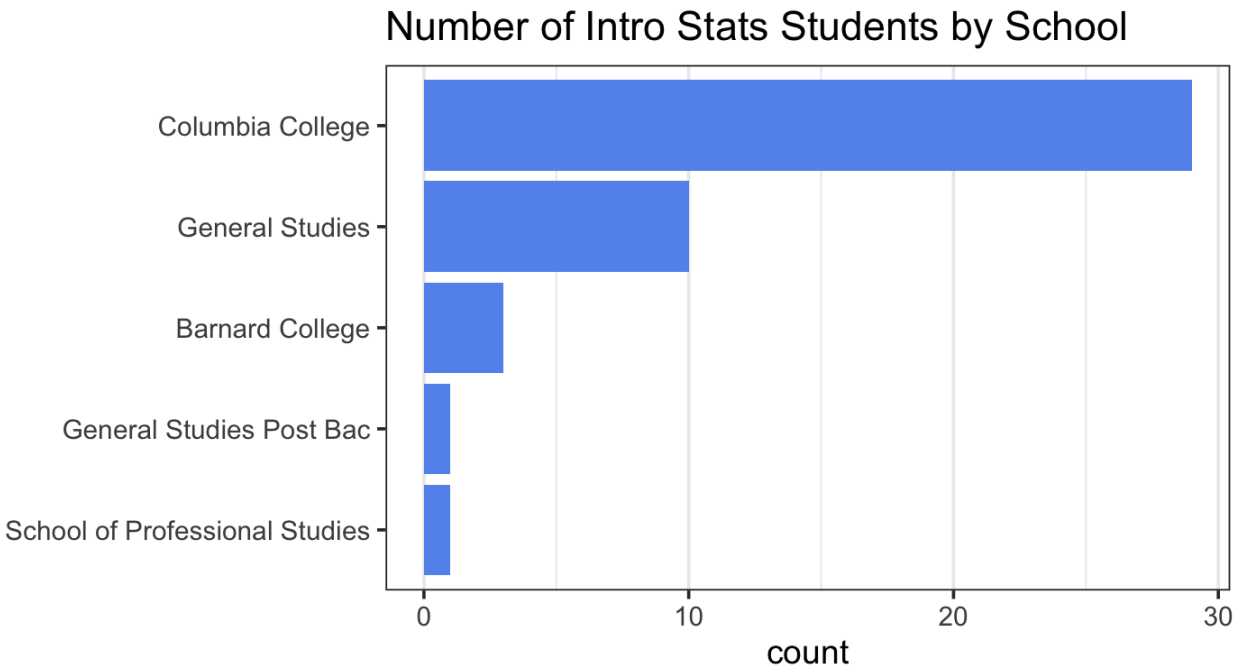
Nominal data

Sort from highest to lowest count (left to right, or top to bottom)

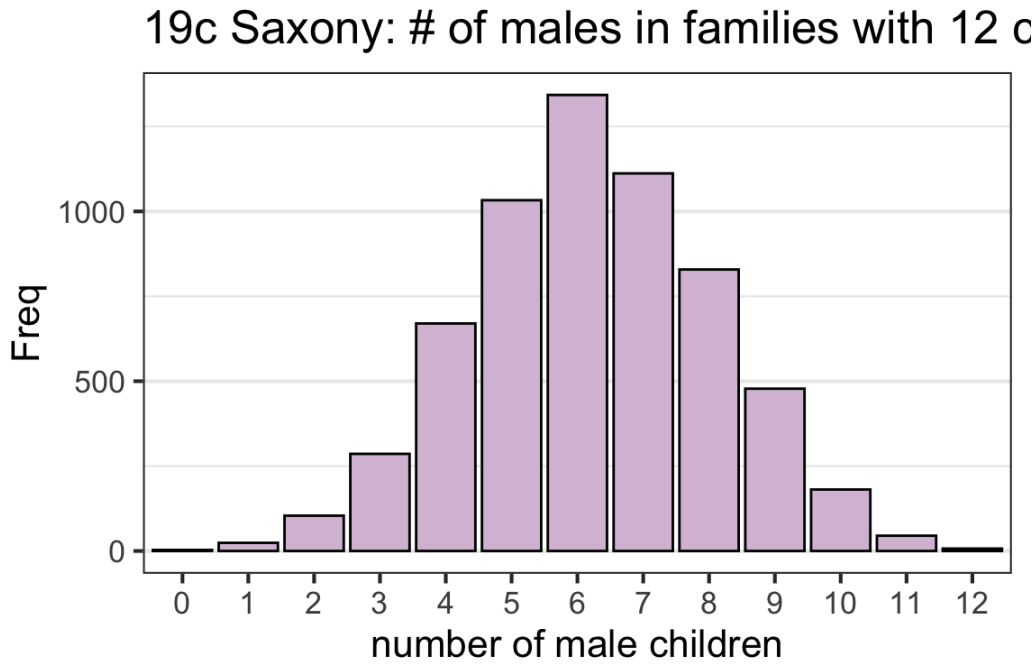


Nominal data

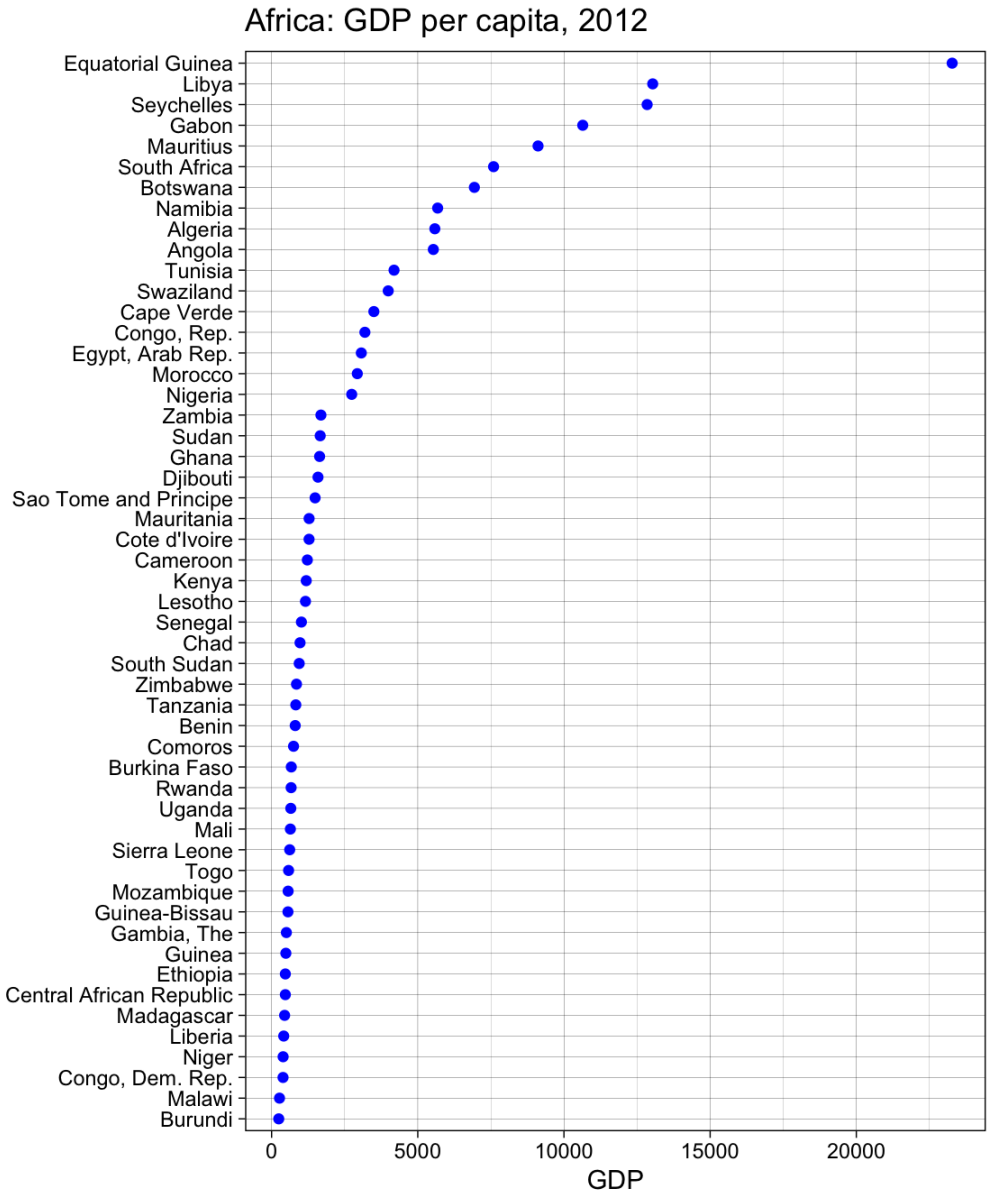
… or top to bottom



Discrete data

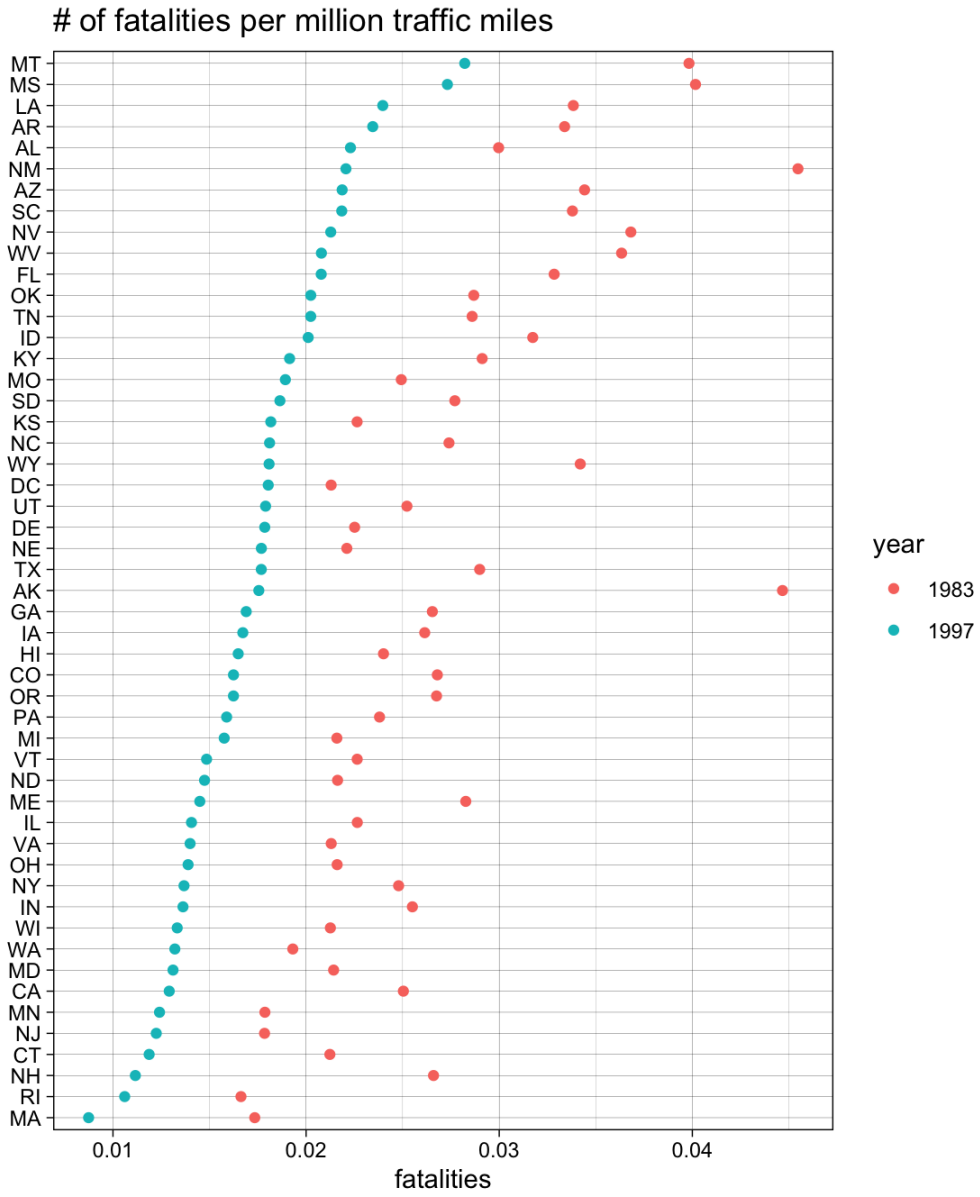


Cleveland dot plot



Cleveland dot plot with multiple dots

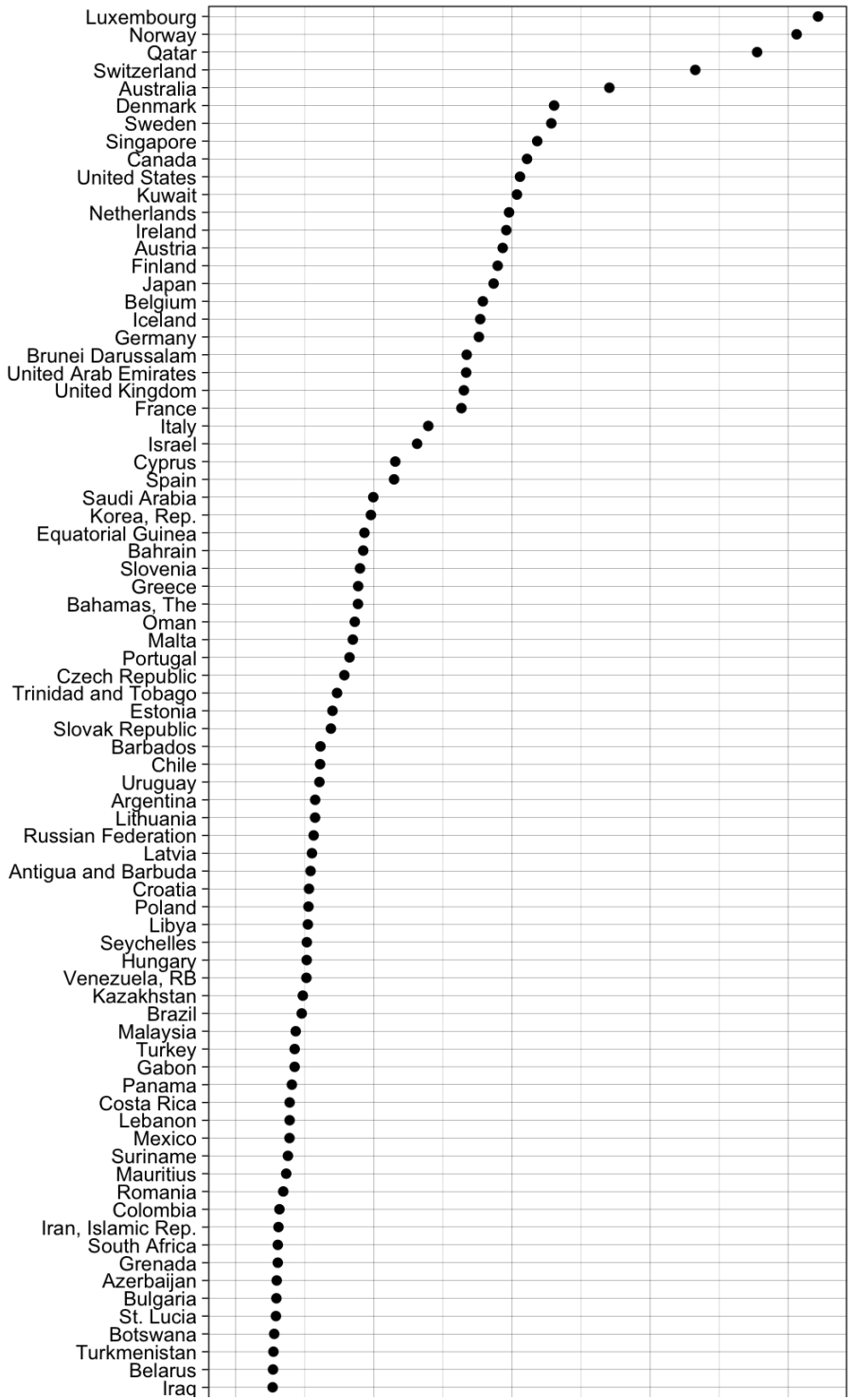
Sorted by 1997 fatality rate



Large number of categories

Scroll

In chunk options: `{r fig.height=20}`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Switzerland
Australia
Denmark
Sweden
Singapore
Canada
United States
Kuwait
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Ireland
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Japan
Belgium
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Brunei Darussalam
United Arab Emirates
United Kingdom
France
Italy
Israel
Cyprus
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Saudi Arabia
Korea, Rep.
Equatorial Guinea
Bahrain
Slovenia
Greece
Bahamas, The
Oman
Malta
Portugal
Czech Republic
Trinidad and Tobago
Estonia
Slovak Republic
Barbados
Chile
Uruguay
Argentina
Lithuania
Russian Federation
Latvia
Antigua and Barbuda
Croatia
Poland
Libya
Seychelles
Hungary
Venezuela, RB
Kazakhstan
Brazil
Malaysia
Turkey
Gabon
Panama
Costa Rica
Lebanon
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Suriname
Mauritius
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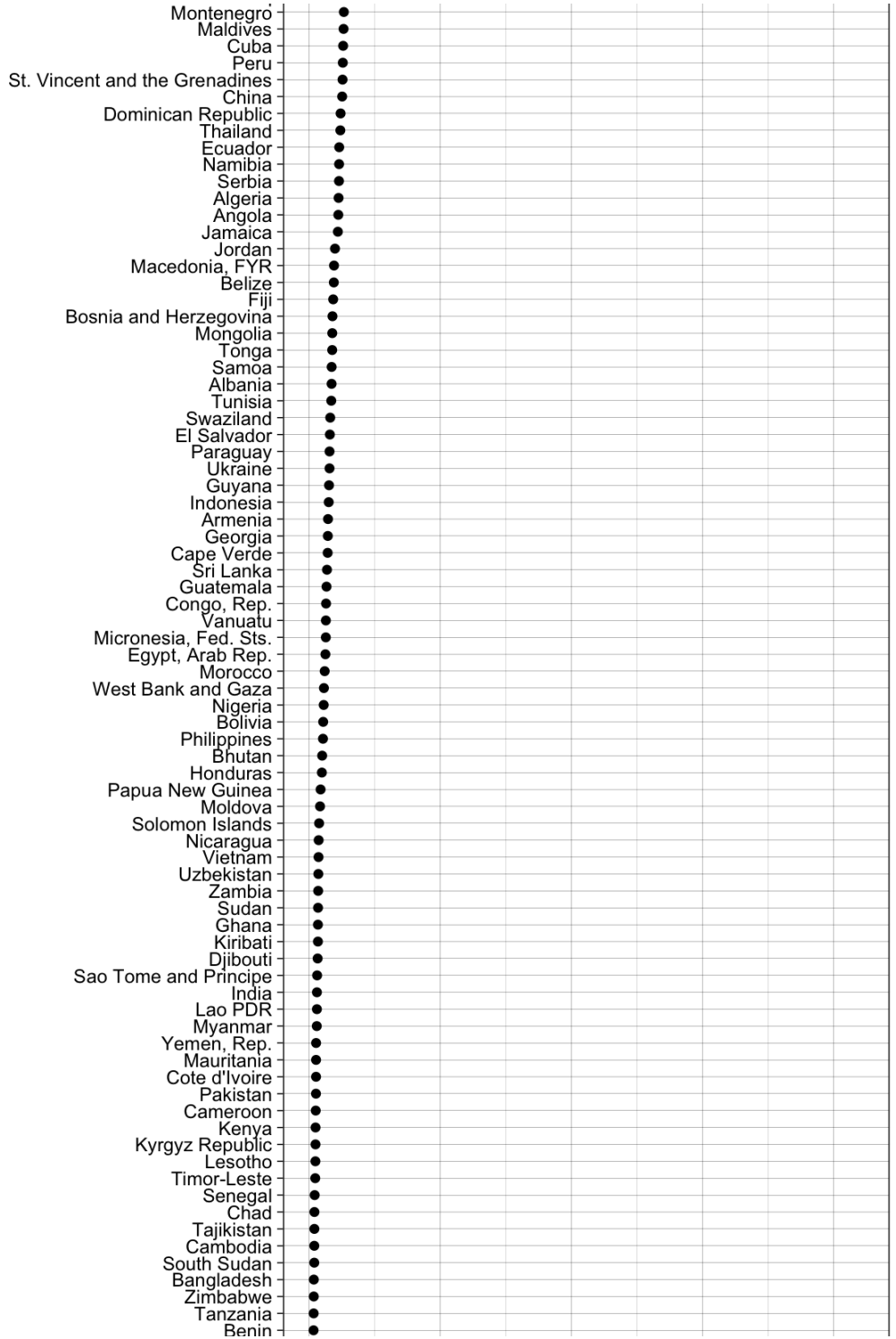
St. Lucia
Botswana
Turkmenistan
Belarus
Iraq


Montenegro
Maldives
Cuba
Peru
St. Vincent and the Grenadines
China
Dominican Republic
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Namibia
Serbia
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Angola
Jamaica
Jordan
Macedonia, FYR
Belize
Fiji
Bosnia and Herzegovina
Mongolia
Tonga
Samoa
Albania
Tunisia
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El Salvador
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Indonesia
Armenia
Georgia
Cape Verde
Sri Lanka
Guatemala
Congo, Rep.
Vanuatu
Micronesia, Fed. Sts.
Egypt, Arab Rep.
Morocco
West Bank and Gaza
Nigeria
Bolivia
Philippines
Bhutan
Honduras
Papua New Guinea
Moldova
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Zambia
Sudan
Ghana
Kiribati
Djibouti
Sao Tome and Principe
India
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Myanmar
Yemen, Rep.
Mauritania
Cote d'Ivoire
Pakistan
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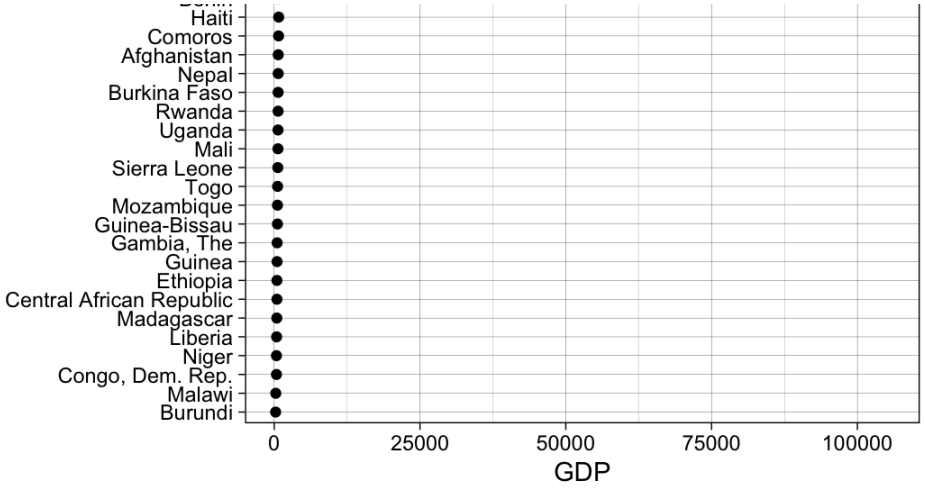
Tanzania
Benin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Comoros
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Madagascar
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Niger
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25000
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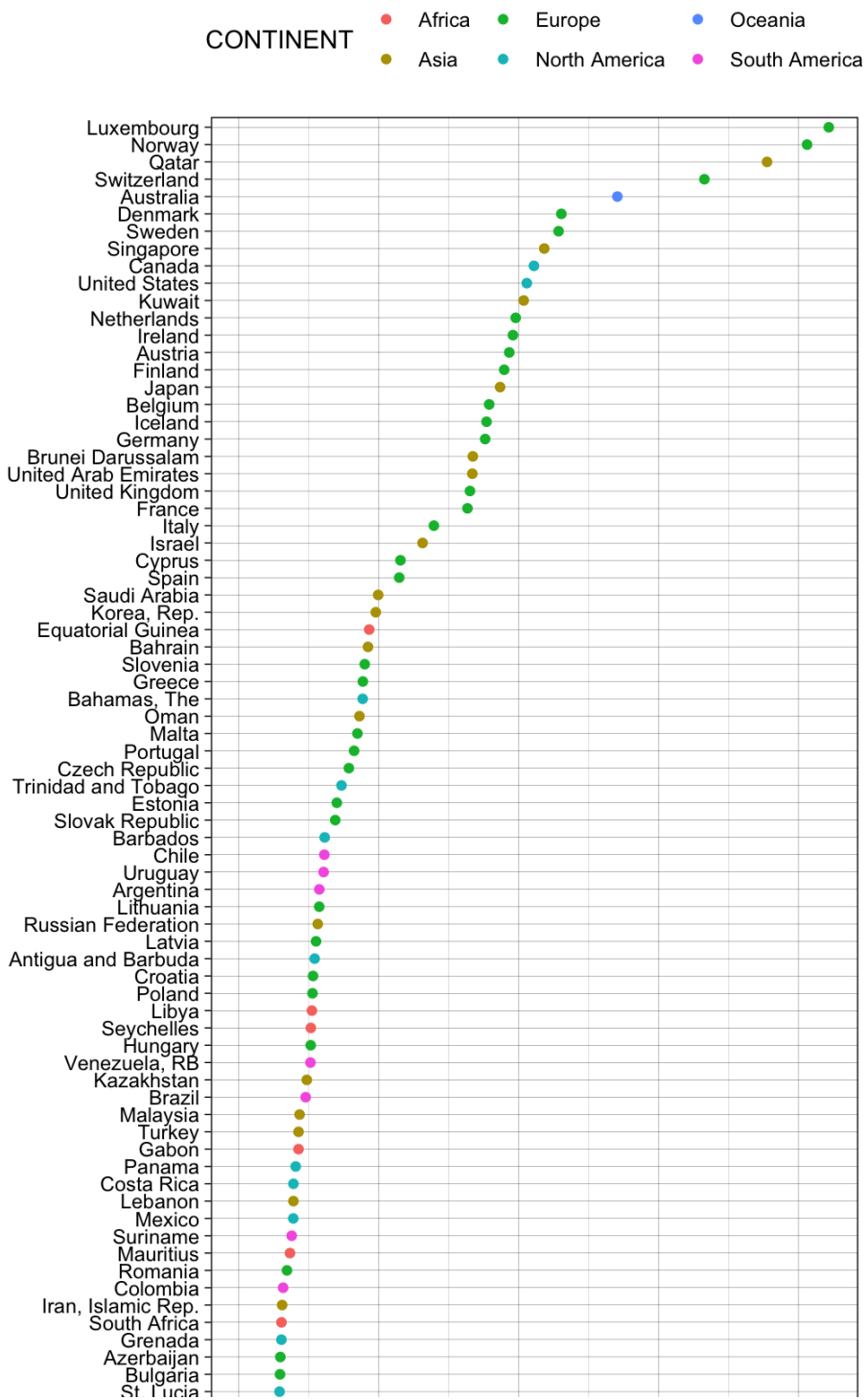
GDP

Large number of categories (with color)

Scroll

In chunk options: `{r fig.height=20}`


CONTINENT
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North America
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Singapore
Canada
United States
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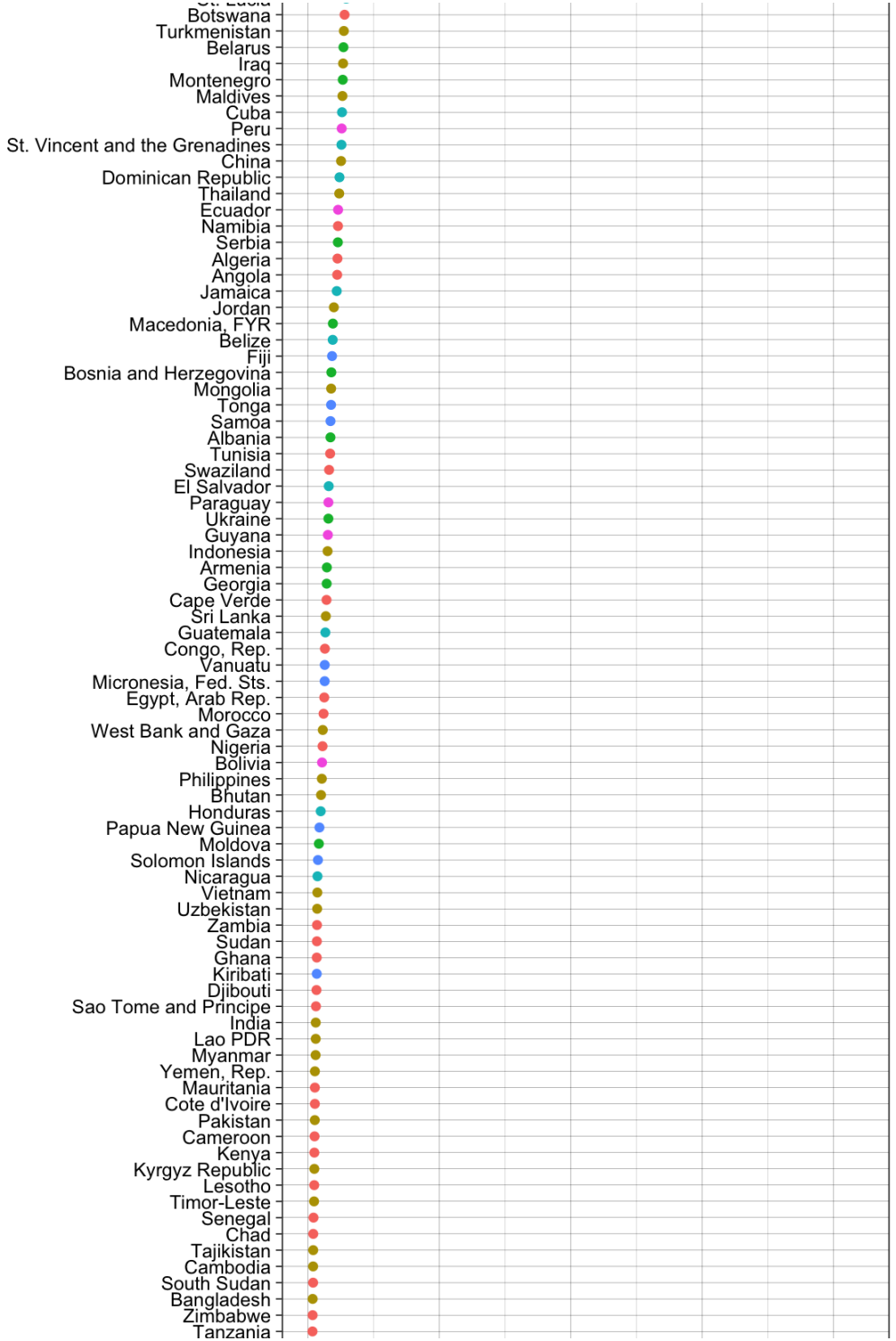
St. Lucia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Ecuador
Namibia
Serbia
Algeria
Angola
Jamaica
Jordan
Macedonia, FYR
Belize
Fiji
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Tunisia
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Ukraine
Guyana
Indonesia
Armenia
Georgia
Cape Verde
Sri Lanka
Guatemala
Congo, Rep.
Vanuatu
Micronesia, Fed. Sts.
Egypt, Arab Rep.
Morocco
West Bank and Gaza
Nigeria
Bolivia
Philippines
Bhutan
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Papua New Guinea
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Solomon Islands
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Djibouti
Sao Tome and Principe
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Lao PDR
Myanmar
Yemen, Rep.
Mauritania
Cote d'Ivoire
Pakistan
Cameroon
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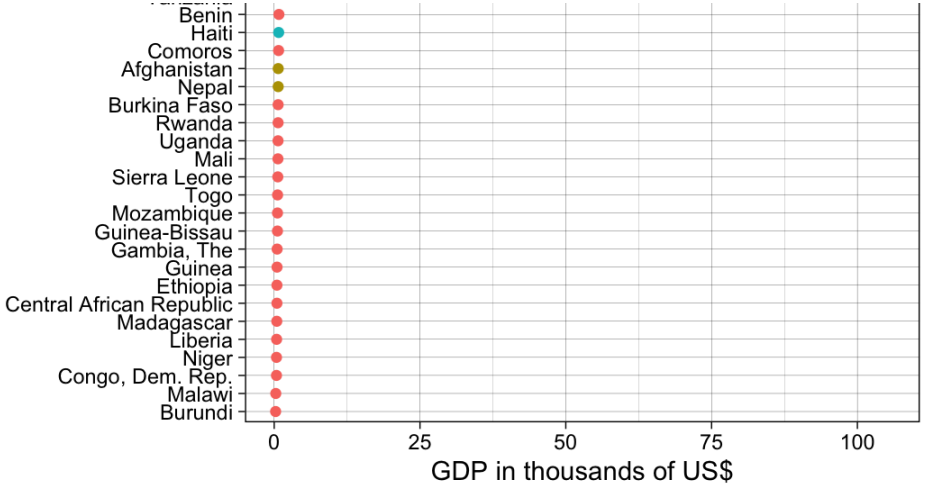
Cambodia
South Sudan
Bangladesh
Zimbabwe
Tanzania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Comoros
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Nepal
Burkina Faso
Rwanda
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Sierra Leone
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Mozambique
Guinea-Bissau
Gambia, The
Guinea
Ethiopia
Central African Republic
Madagascar
Liberia
Niger
Congo, Dem. Rep.
Malawi
Burundi
0
25
50
75
100
GDP in thousands of US$

Cleveland dot plot with facets

What's wrong?


Europe
South America
North America
Asia
Oceania
Africa
Luxembourg
Norway
Qatar
Switzerland
Australia
Denmark
Sweden
Singapore
Canada
United States
Kuwait
Netherlands
Ireland
Austria
Finland
Japan
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United Arab Emirates
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Saudi Arabia
Korea, Rep.
Equatorial Guinea
Bahrain
Slovenia
Greece
Bahamas, The
Oman
Malta
Portugal
Czech Republic
Trinidad and Tobago
Estonia
Slovak Republic
Barbados
Chile
Uruguay
Argentina
Lithuania
Russian Federation
Latvia
Antigua and Barbuda
Croatia
Poland
Libya
Seychelles
Hungary
Venezuela, RB
Kazakhstan
Brazil
Malaysia
Turkey
Gabon
Panama
Costa Rica
Lebanon
Mexico
Suriname
Mauritius
Romania
Colombia
Iran, Islamic Rep.
South Africa
Grenada
Azerbaijan
Bulgaria
St. Lucia
Botswana
Turkmenistan
Belarus


reorder(COUNTRY, GDP)
Iraq
Montenegro
Maldives
Cuba
Peru
St. Vincent and the Grenadines
China
Dominican Republic
Thailand
Ecuador
Namibia
Serbia
Algeria
Angola
Jamaica
Jordan
Macedonia, FYR
Belize
Fiji
Bosnia and Herzegovina
Mongolia
Tonga
Samoa
Albania
Tunisia
Swaziland
El Salvador
Paraguay
Ukraine
Guyana
Indonesia
Armenia
Georgia
Cape Verde
Sri Lanka
Guatemala
Congo, Rep.
Vanuatu
Micronesia, Fed. Sts.
Egypt, Arab Rep.
Morocco
West Bank and Gaza
Nigeria
Bolivia
Philippines
Bhutan
Honduras
Papua New Guinea
Moldova
Solomon Islands
Nicaragua
Vietnam
Uzbekistan
Zambia
Sudan
Ghana
Kiribati
Djibouti
Sao Tome and Principe
India
Lao PDR
Myanmar
Yemen, Rep.
Mauritania
Cote d'Ivoire
Pakistan
Cameroon
Kenya
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Lesotho
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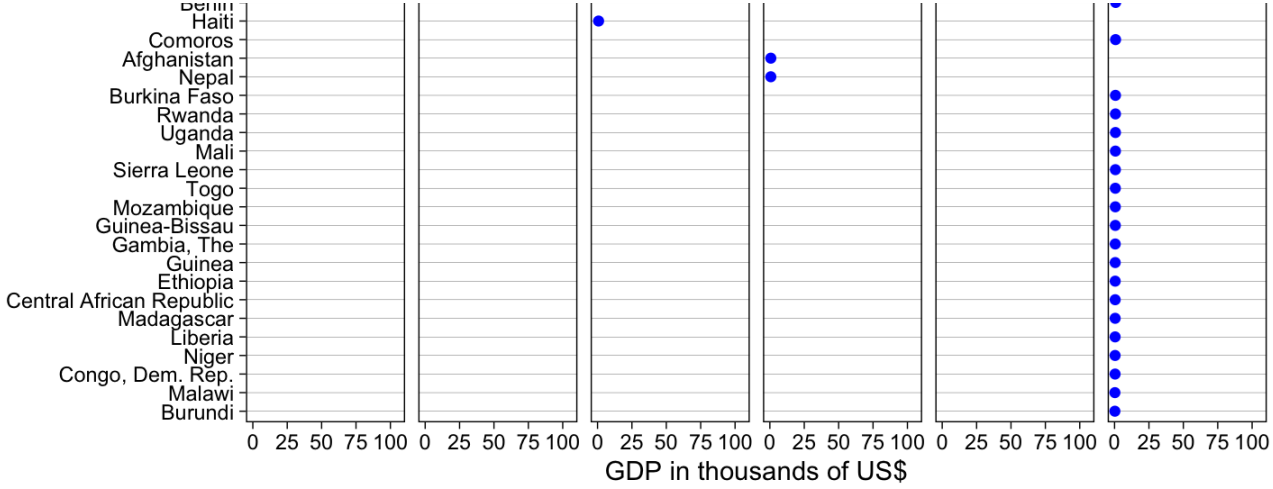
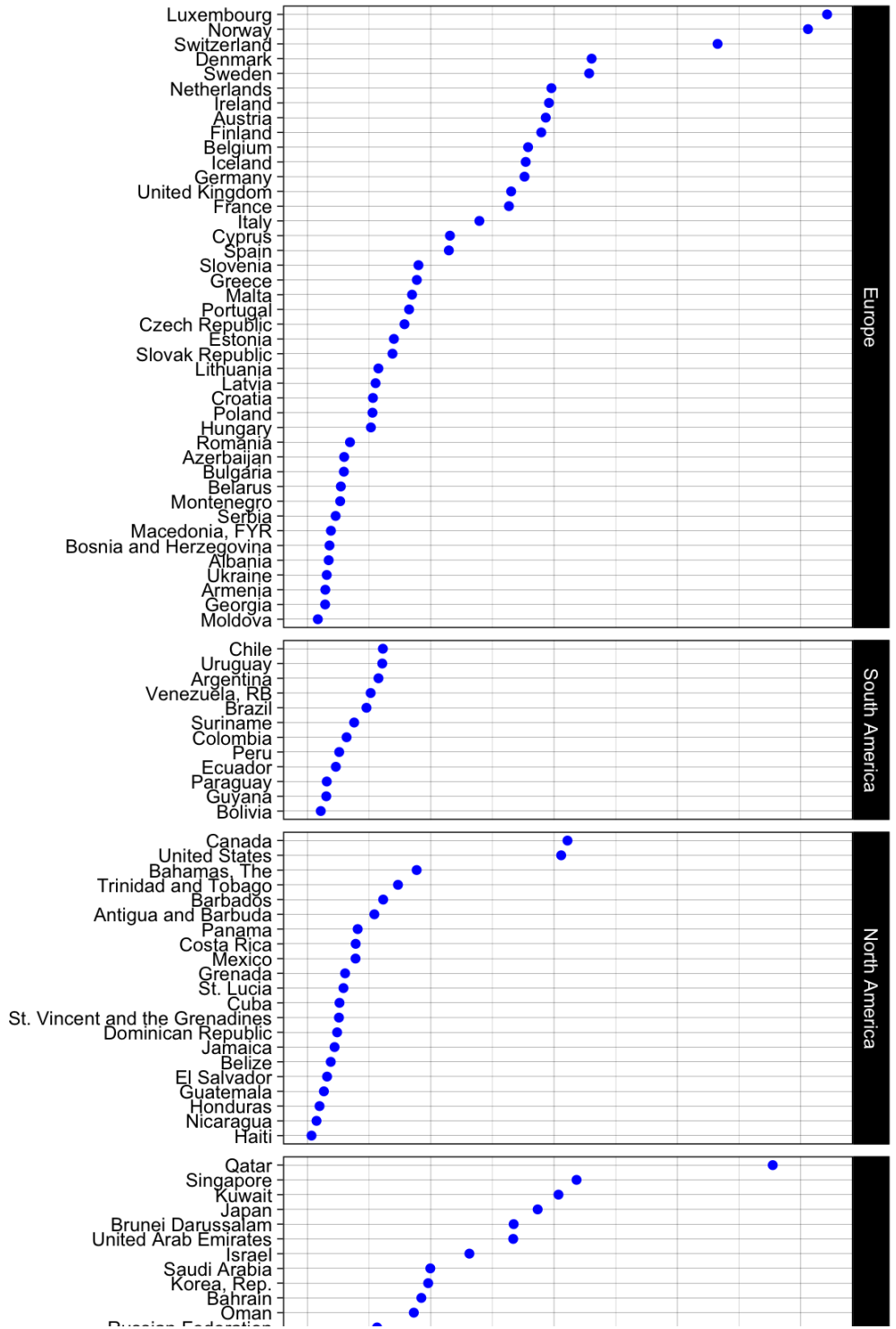
Tajikistan
Cambodia
South Sudan
Bangladesh
Zimbabwe
Tanzania


Haiti
Comoros
Afghanistan
Nepal
Burkina Faso
Rwanda
Uganda
Mali
Sierra Leone
Togo
Mozambique
Guinea-Bissau
Gambia, The
Guinea
Ethiopia
Central African Republic
Madagascar
Liberia
Niger
Congo, Dem. Rep.
Malawi
Burundi
0 25 50 75 100
GDP in thousands of US$

Cleveland dot plot with facets

```
scales = "free_y", space = "free_y"
```


Luxembourg
Norway
Switzerland
Denmark
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Cyprus
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Lithuania
Latvia
Croatia
Poland
Hungary
Romania
Azerbaijan
Bulgaria
Belarus
Montenegro
Serbia
Macedonia, FYR
Bosnia and Herzegovina
Albania
Ukraine
Armenia
Georgia
Moldova
Europe
Chile
Uruguay
Argentina
Venezuela, RB
Brazil
Suriname
Colombia
Peru
Ecuador
Paraguay
Guyana
Bolivia
South America
Canada
United States
Bahamas, The
Trinidad and Tobago
Barbados
Antigua and Barbuda
Panama
Costa Rica
Mexico
Grenada
St. Lucia
Cuba
St. Vincent and the Grenadines
Dominican Republic
Jamaica
Belize
El Salvador
Guatemala
Honduras
Nicaragua
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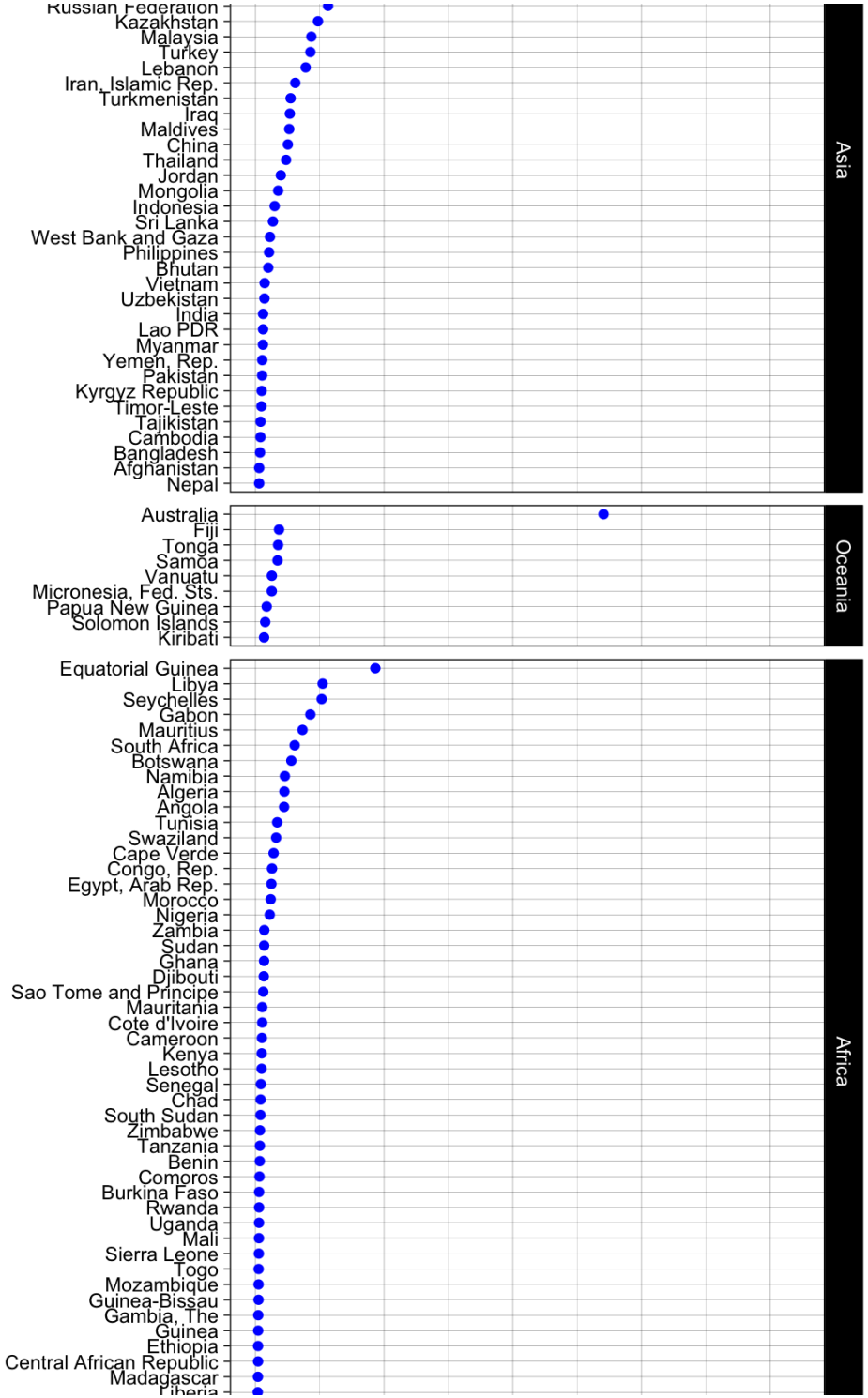
Korea, Rep.
Bahrain
Oman


Russian Federation
Kazakhstan
Malaysia
Turkey
Lebanon
Iran, Islamic Rep.
Turkmenistan
Iraq
Maldives
China
Thailand
Jordan
Mongolia
Indonesia
Sri Lanka
West Bank and Gaza
Philippines
Bhutan
Vietnam
Uzbekistan
India
Lao PDR
Myanmar
Yemen, Rep.
Pakistan
Kyrgyz Republic
Timor-Leste
Tajikistan
Cambodia
Bangladesh
Afghanistan
Nepal
Asia
Australia
Fiji
Tonga
Samoa
Vanuatu
Micronesia, Fed. Sts.
Papua New Guinea
Solomon Islands
Kiribati
Oceania
Equatorial Guinea
Libya
Seychelles
Gabon
Mauritius
South Africa
Botswana
Namibia
Algeria
Angola
Tunisia
Swaziland
Cape Verde
Congo, Rep.
Egypt, Arab Rep.
Morocco
Nigeria
Zambia
Sudan
Ghana
Djibouti
Sao Tome and Principe
Mauritania
Cote d'Ivoire
Cameroon
Kenya
Lesotho
Senegal
Chad
South Sudan
Zimbabwe
Tanzania
Benin
Comoros
Burkina Faso
Rwanda
Uganda
Mali
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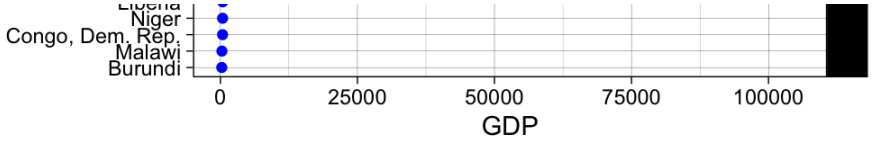
Guinea-Bissau
Gambia, The
Guinea
Ethiopia
Central African Republic
Madagascar
Liberia
Africa


Liberia
Niger
Congo, Dem. Rep.
Malawi
Burundi
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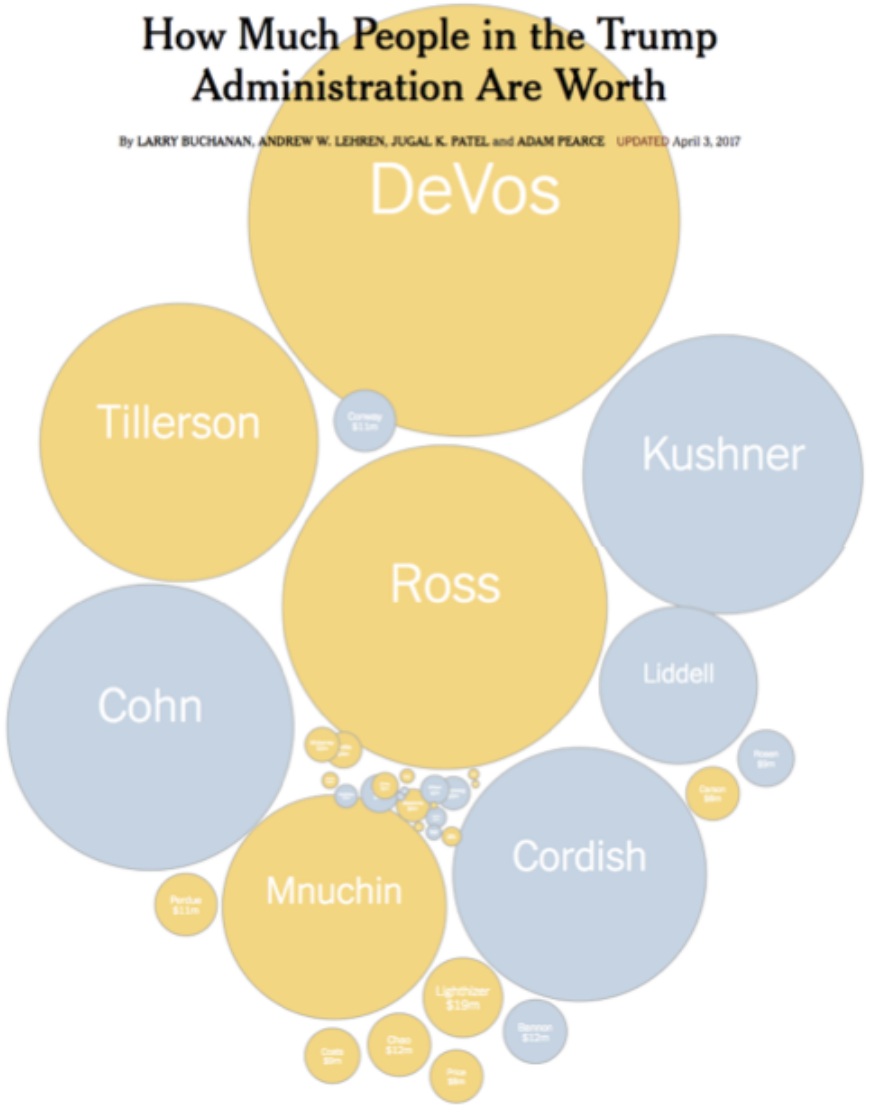
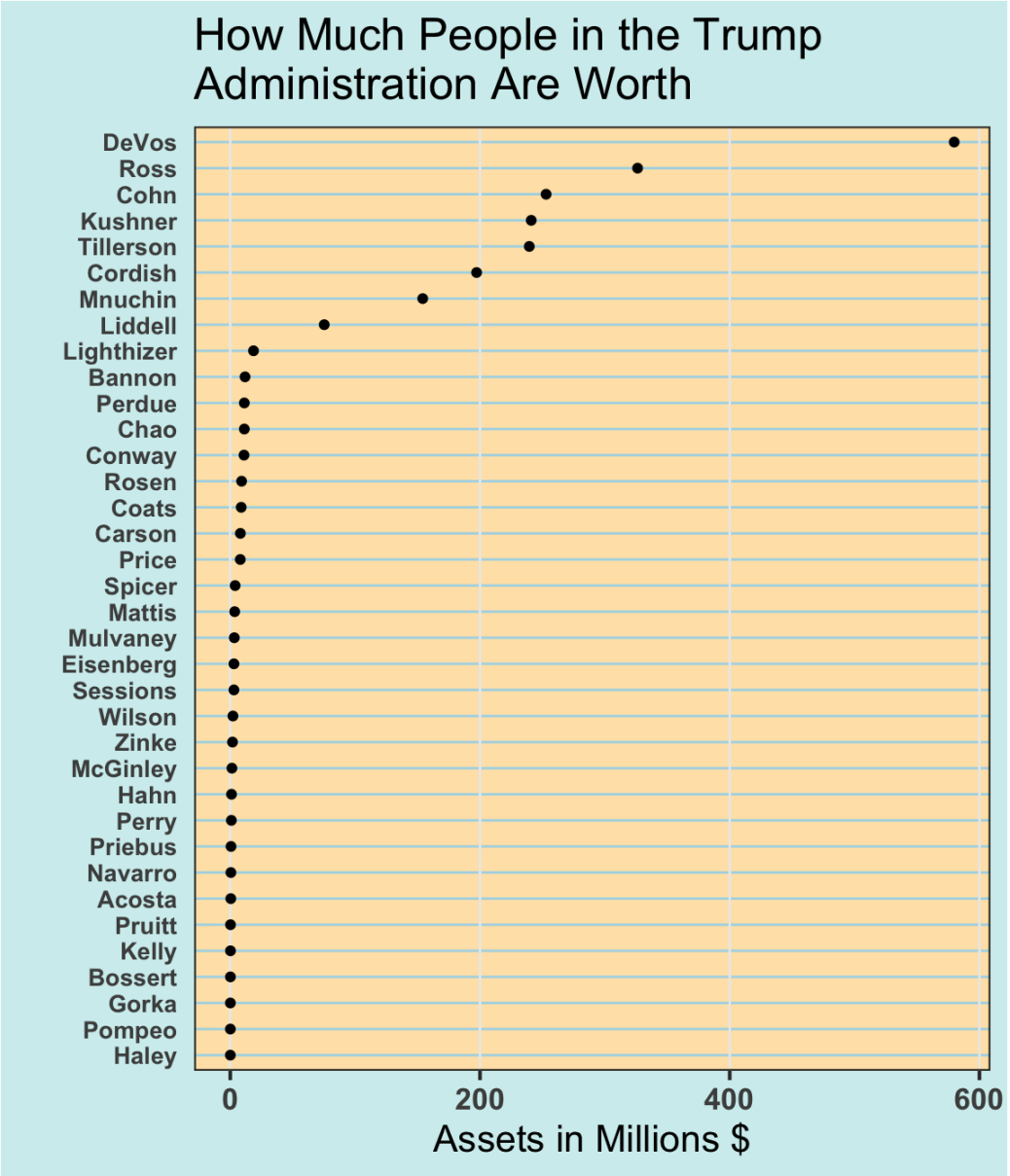
75000
100000
GDP

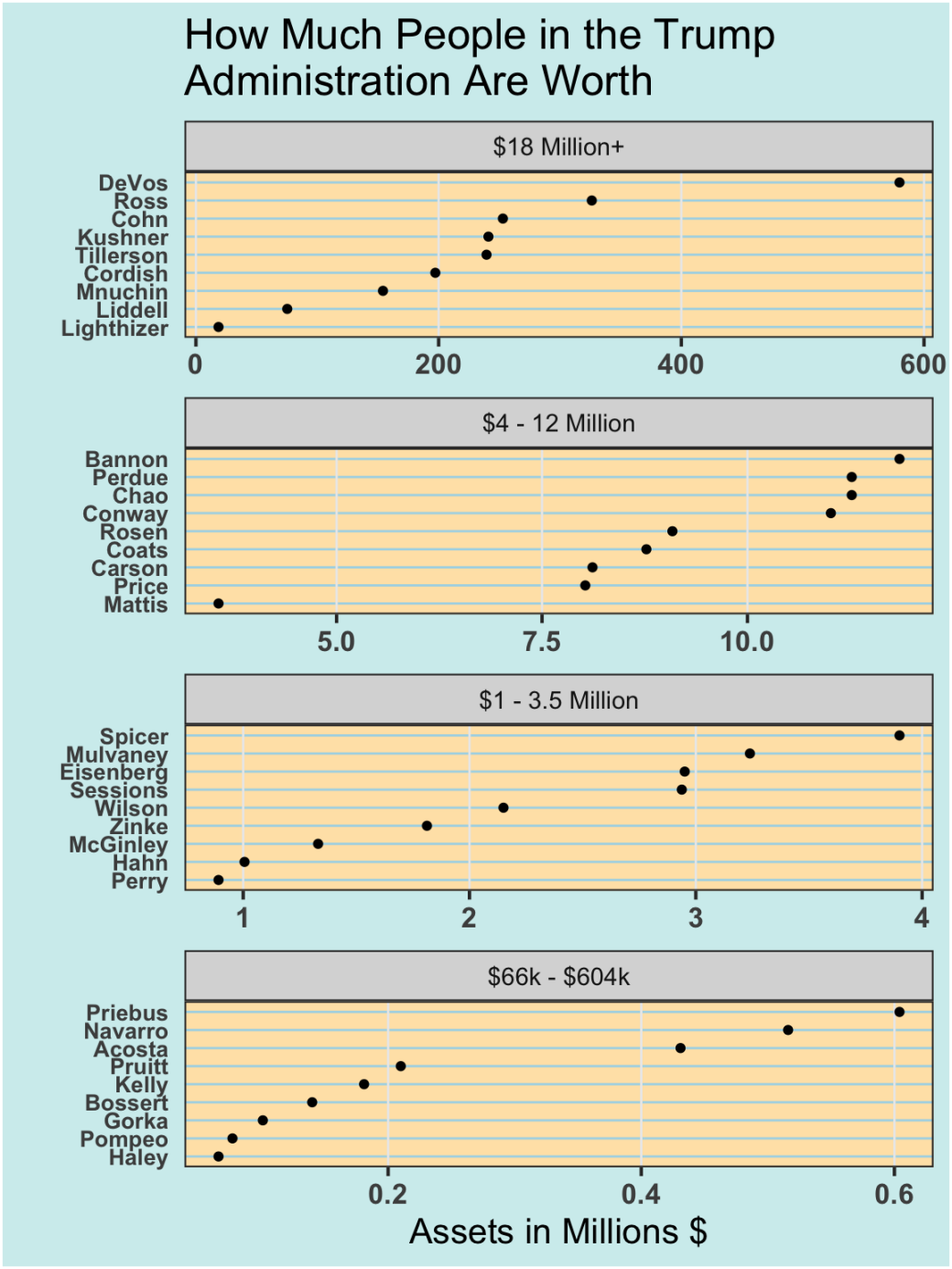
Trump Administration Assets



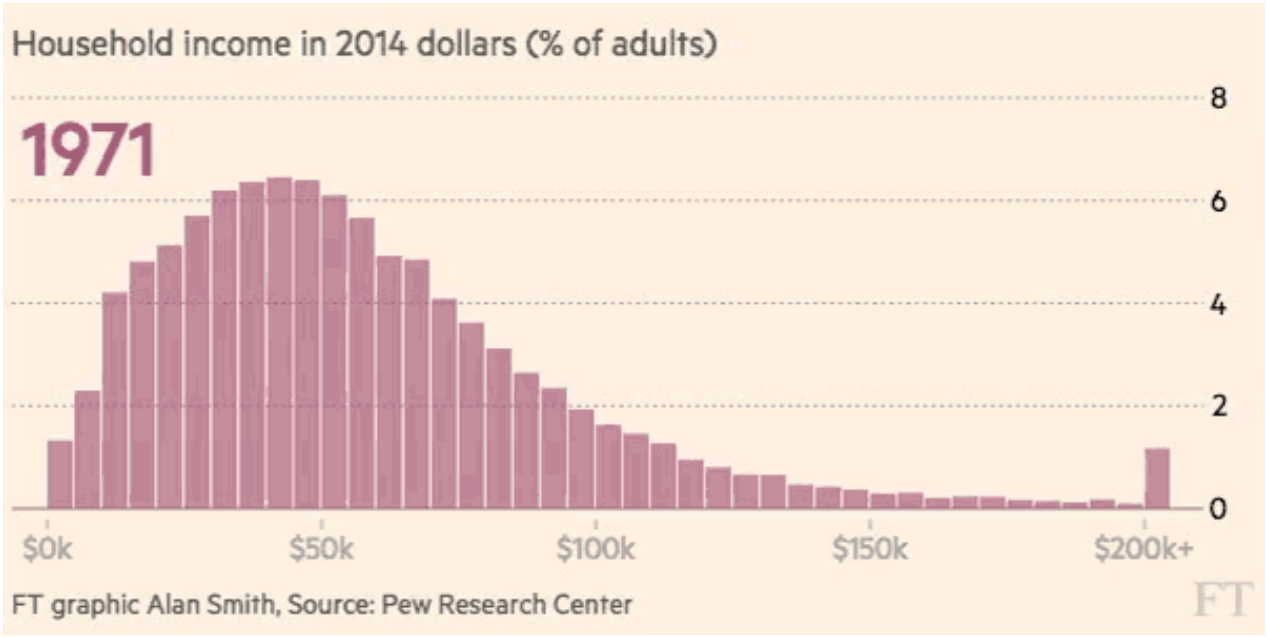
Redraw as Cleveland Dot Plot



Cleveland Dot Plot with Panels


How Much People in the Trump Administration Are Worth
$18 Million+
DeVos
Ross
Cohn
Kushner
Tillerson
Cordish
Mnuchin
Liddell
Lighthizer
0
200
400
600
$4 - 12 Million
Bannon
Perdue
Chao
Conway
Rosen
Coats
Carson
Price
Mattis
5.0
7.5
10.0
$1 - 3.5 Million
Spicer
Mulvaney
Eisenberg
Sessions
Wilson
Zinke
McGinley
Hahn
Perry
1
2
3
4
$66k - $604k
Priebus
Navarro
Acosta
Pruitt
Kelly
Bossert
Gorka
Pompeo
Haley
0.2
0.4
0.6
Assets in Millions $

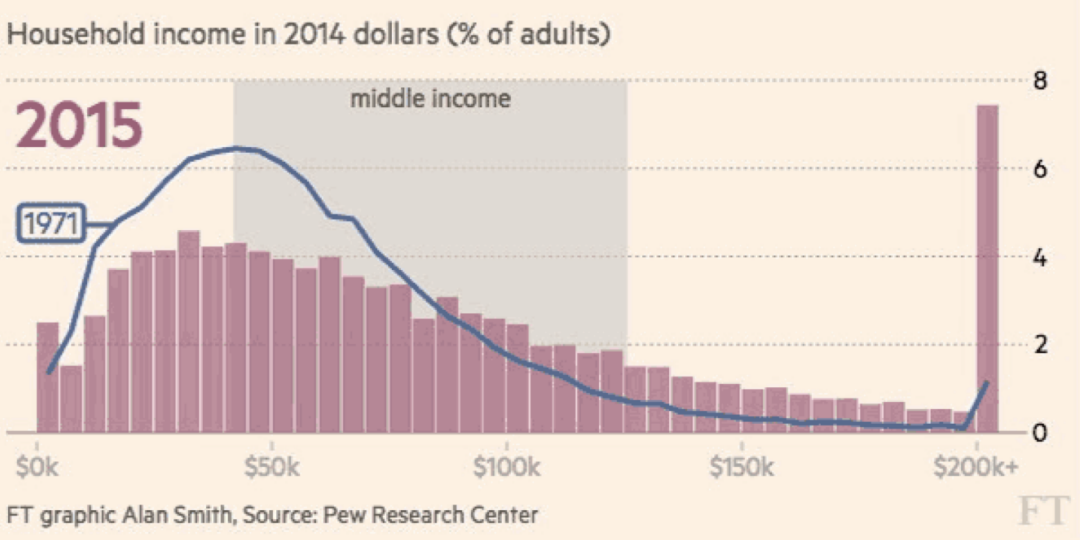
“Other” “or more” categories: “topcoding”



Source: “America’s explosion of income inequality, in one amazing animated chart”

http://www.latimes.com/business/hiltzik/la-fi-hiltzik-ft-graphic-20160320-snap-htmlstory.html

“Other” “or more” categories: “topcoding”



Source: “America’s explosion of income inequality, in one amazing animated chart”

http://www.latimes.com/business/hiltzik/la-fi-hiltzik-ft-graphic-20160320-snap-htmlstory.html

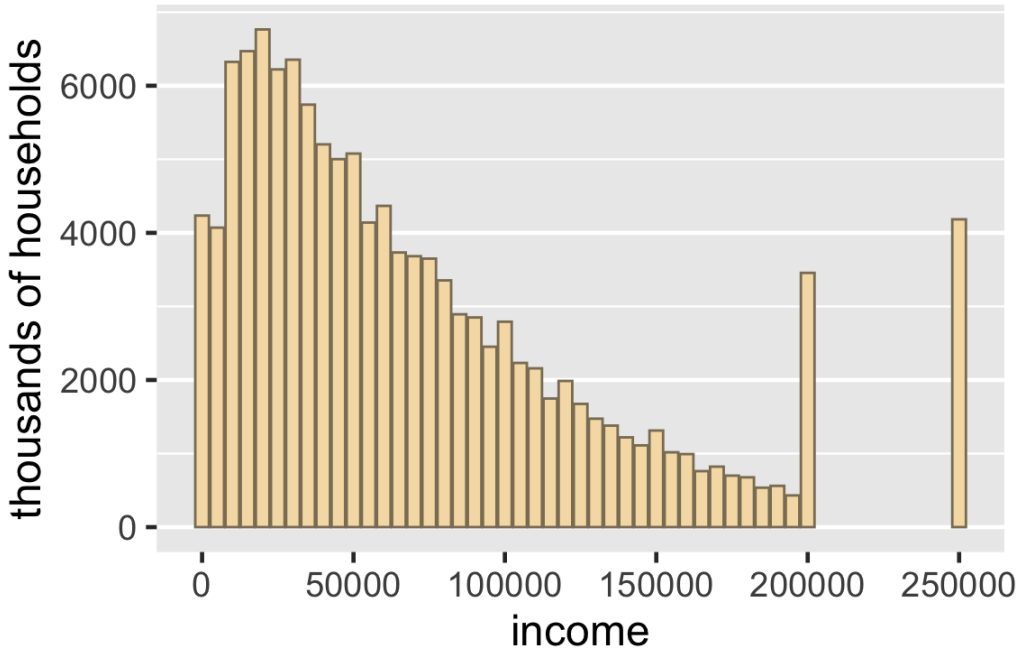
“Other” “or more” categories

$82,500 to $84,999	$85,000 to $87,499	$87,500 to $89,999	$90,000 to $92,499	$92,500 to $94,999	$95,000 to $97,499	$97,500 to $99,999	$100,000 and over	Va (D
1,102	1,683	892	2,065	894	1,306	770	22,426	

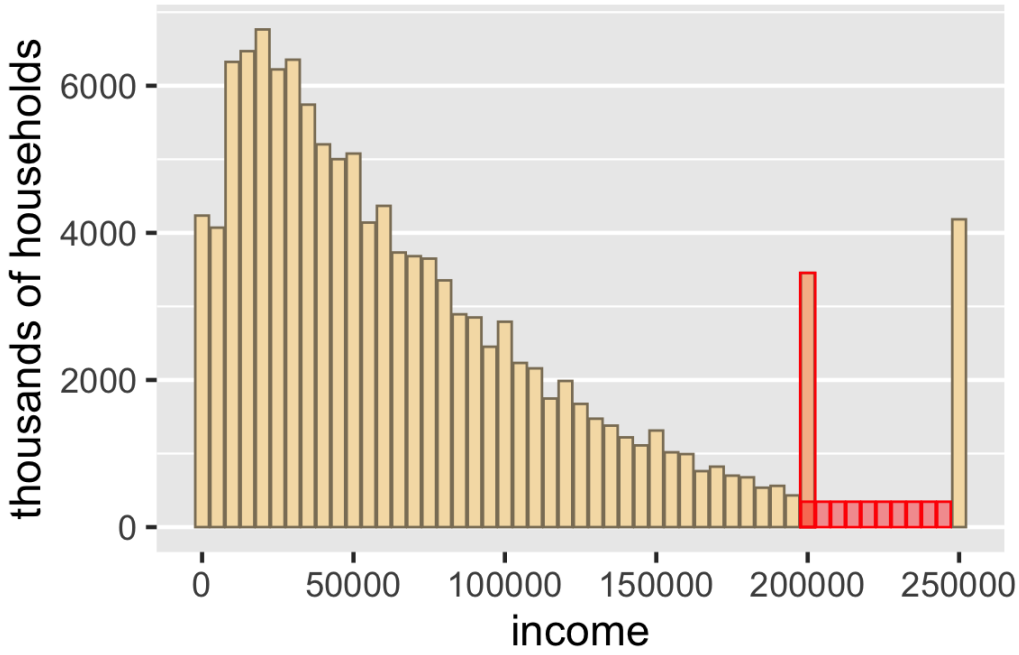
$82,500 to $84,999	$85,000 to $87,499	$87,500 to $89,999	$90,000 to $92,499	$92,500 to $94,999	$95,000 to $97,499	$97,500 to $99,999	$100,000 and over	Va (D
973	1,520	775	1,880	824	1,172	711	20,773	
323	550	265	634	309	381	238	7,479	
650	970	509	1,246	515	790	473	13,295	
129	163	117	185	70	134	59	1,653	

Source: https://www2.census.gov/programs-surveys/cps/tables/pinc-01/2017/pinc01_1_1_1.xls

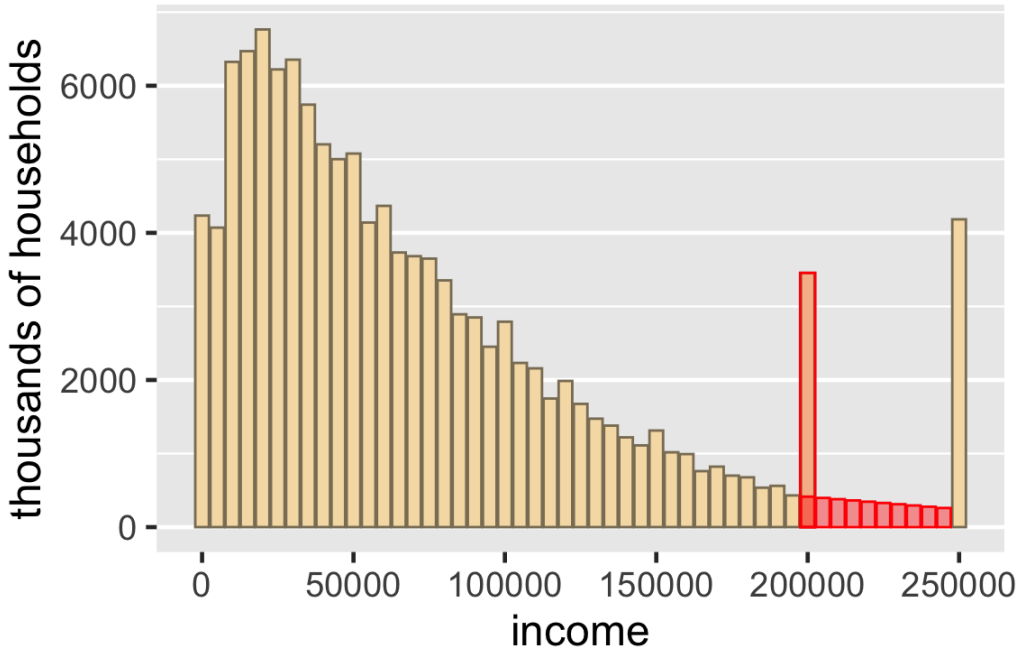
Household Income in 2015



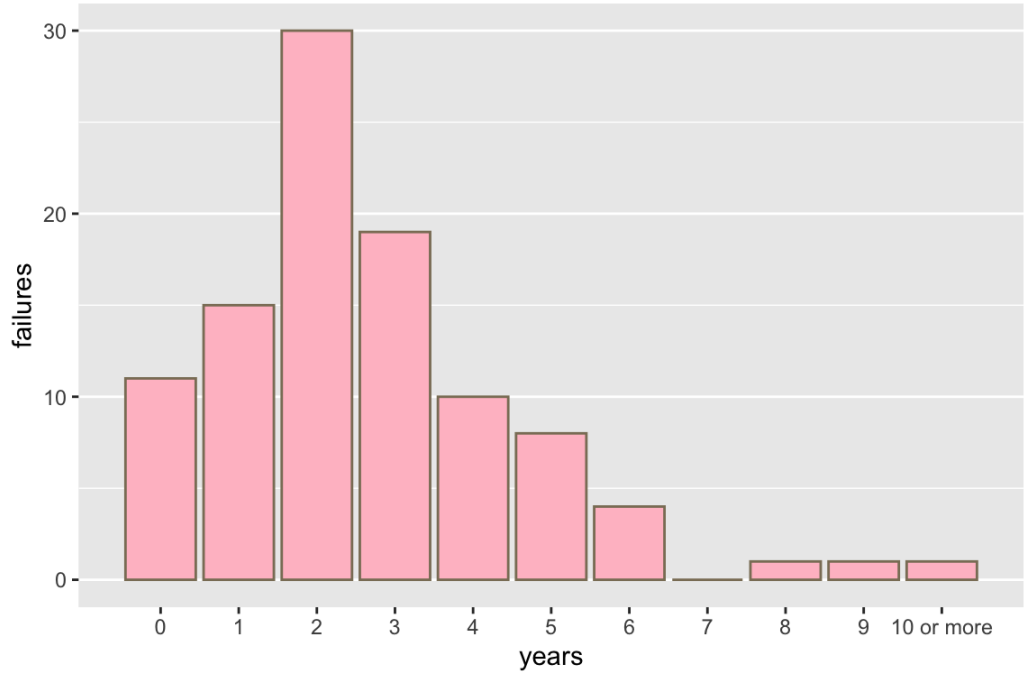
Household Income in 2015



Household Income in 2015



Reasonable use of “or more”



Data cleaning / transforming

http://toddwschneider.com/posts/the-simpsons-by-the-data/