PLSC 502 – Fall 2024
Descriptive Graphics

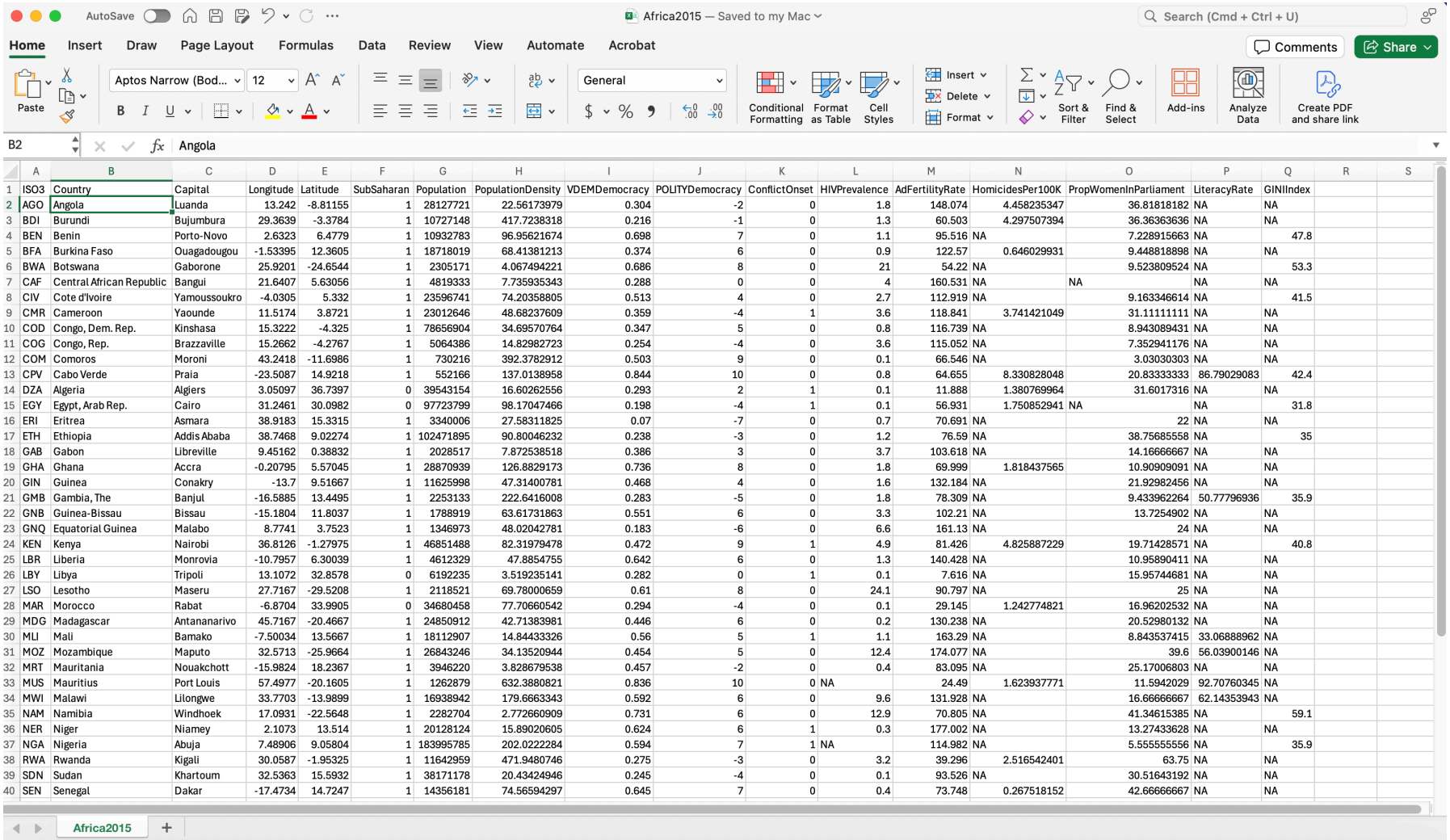
September 16, 2024

Why Plot?

We use plots to:

- Know your data.
- Catch mistakes.
- Learn something...

Example: Africa, 2015



ISO3	Country	Capital	Longitude	Latitude	SubSaharan	Population	PopulationDensity	VDEMDemocracy	POLITYDemocracy	ConflictOnset	HIVPrevalence	AdFertilityRate	HomicidesPer100K	PropWomenInParliament	LiteracyRate	GINIIndex
AGO	Angola	Luanda	13.242	-8.81155	1	28127721	22.56173979	0.304	-2	0	1.8	148.074	4.458235347	36.81818182	NA	NA
BDI	Burundi	Bujumbura	29.3639	-3.3784	1	10727148	417.7238318	0.216	-1	0	1.3	60.503	4.297507394	36.36363636	NA	NA
BEN	Benin	Porto-Novo	2.6323	6.4779	1	10932783	96.95621674	0.698	7	0	1.1	95.516	NA	7.228915663	NA	47.8
BFA	Burkina Faso	Ouagadougou	-1.53395	12.3605	1	18718019	68.41381213	0.374	6	0	0.9	122.57	0.646029931	9.448818898	NA	NA
BWA	Botswana	Gaborone	25.9201	-24.6544	1	2305171	4.067494221	0.686	8	0	21	54.22	NA	9.523809524	NA	53.3
CAF	Central African Republic	Bangui	21.6407	5.63056	1	4819333	7.735935343	0.288	0	0	4	160.531	NA	NA	NA	NA
CIV	Cote d'Ivoire	Yamoussoukro	-4.0305	5.332	1	23596741	74.20358805	0.513	4	0	2.7	112.919	NA	9.163346614	NA	41.5
CMR	Cameroon	Yaounde	11.5174	3.8721	1	23012646	48.68237609	0.359	-4	1	3.6	118.841	3.741421049	31.11111111	NA	NA
COD	Congo, Dem. Rep.	Kinshasa	15.3222	-4.325	1	78656904	34.69570764	0.347	5	0	0.8	116.739	NA	8.943089431	NA	NA
COG	Congo, Rep.	Brazzaville	15.2662	-4.2767	1	5064386	14.82982723	0.254	-4	0	3.6	115.052	NA	7.352941176	NA	NA
COM	Comoros	Moroni	43.2418	-11.6986	1	730216	392.3782912	0.503	9	0	0.1	66.546	NA	3.03030303	NA	NA
CPV	Cabo Verde	Praia	-23.5087	14.9218	1	552166	137.0138958	0.844	10	0	0.8	64.655	8.330828048	20.83333333	86.79029083	42.4
DZA	Algeria	Algiers	3.05097	36.7397	0	39543154	16.60262556	0.293	2	1	0.1	11.888	1.380769964	31.6017316	NA	NA
EGY	Egypt, Arab Rep.	Cairo	31.2461	30.0982	0	97723799	98.17047466	0.198	-4	1	0.1	56.931	1.750852941	NA	NA	31.8
ERI	Eritrea	Asmara	38.9183	15.3315	1	3340006	27.58311825	0.07	-7	0	0.7	70.691	NA	22	NA	NA
ETH	Ethiopia	Addis Ababa	38.7468	9.02274	1	102471895	90.80046232	0.238	-3	0	1.2	76.59	NA	38.75685558	NA	35
GAB	Gabon	Libreville	9.45162	0.38832	1	2028517	7.872538518	0.386	3	0	3.7	103.618	NA	14.16666667	NA	NA
GHA	Ghana	Accra	-0.20795	5.57045	1	28870939	126.8829173	0.736	8	0	1.8	69.999	1.818437565	10.90909091	NA	NA
GIN	Guinea	Conakry	-13.7	9.51667	1	11625998	47.31400781	0.468	4	0	1.6	132.184	NA	21.92982456	NA	NA
GMB	Gambia, The	Banjul	-16.5885	13.4495	1	2253133	222.6416008	0.283	-5	0	1.8	78.309	NA	9.433962264	50.77796936	35.9
GNB	Guinea-Bissau	Bissau	-15.1804	11.8037	1	1788919	63.61731863	0.551	6	0	3.3	102.21	NA	13.7254902	NA	NA
GNQ	Equatorial Guinea	Malabo	8.7741	3.7523	1	1346973	48.02042781	0.183	-6	0	6.6	161.13	NA	24	NA	NA
KEN	Kenya	Nairobi	36.8126	-1.27975	1	46851488	82.31979478	0.472	9	1	4.9	81.426	4.825887229	19.71428571	NA	40.8
LBR	Liberia	Monrovia	-10.7957	6.30039	1	4612329	47.8854755	0.642	6	0	1.3	140.428	NA	10.95890411	NA	NA
LBY	Libya	Tripoli	13.1072	32.8578	0	6192235	3.519235141	0.282	0	1	0.1	7.616	NA	15.95744681	NA	NA
LSO	Lesotho	Maseru	27.7167	-29.5208	1	2118521	69.78000659	0.61	8	0	24.1	90.797	NA	25	NA	NA
MAR	Morocco	Rabat	-6.8704	33.9905	0	34680458	77.70660542	0.294	-4	0	0.1	29.145	1.242774821	16.96202532	NA	NA
MDG	Madagascar	Antananarivo	45.7167	-20.4667	1	24850912	42.71383981	0.446	6	0	0.2	130.238	NA	20.52980132	NA	NA
MLI	Mali	Bamako	-7.50034	13.5667	1	18112907	14.84433326	0.56	5	1	1.1	163.29	NA	8.843537415	33.06888962	NA
MOZ	Mozambique	Maputo	32.5713	-25.9664	1	26843246	34.13520944	0.454	5	0	12.4	174.077	NA	39.6	56.03900146	NA
MRT	Mauritania	Nouakchott	-15.9824	18.2367	1	3946220	3.828679538	0.457	-2	0	0.4	83.095	NA	25.17006803	NA	NA
MUS	Mauritius	Port Louis	57.4977	-20.1605	1	1262879	632.3880821	0.836	10	0	NA	24.49	1.623937771	11.5942029	92.70760345	NA
MWI	Malawi	Lilongwe	33.7703	-13.9899	1	16938942	179.6663343	0.592	6	0	9.6	131.928	NA	16.66666667	62.14353943	NA
NAM	Namibia	Windhoek	17.0931	-22.5648	1	2282704	2.772660909	0.731	6	0	12.9	70.805	NA	41.34615385	NA	59.1
NER	Niger	Niamey	2.1073	13.514	1	20128124	15.89020605	0.624	6	1	0.3	177.002	NA	13.27433628	NA	NA
NGA	Nigeria	Abuja	7.48906	9.05804	1	183995785	202.0222284	0.594	7	1	NA	114.982	NA	5.555555556	NA	35.9
RWA	Rwanda	Kigali	30.0587	-1.95325	1	11642959	471.9480746	0.275	-3	0	3.2	39.296	2.516542401	63.75	NA	NA
SDN	Sudan	Khartoum	32.5363	15.5932	1	38171178	20.43424946	0.245	-4	0	0.1	93.526	NA	30.51643192	NA	NA
SEN	Senegal	Dakar	-17.4734	14.7247	1	14356181	74.56594297	0.645	7	0	0.4	73.748	0.267518152	42.66666667	NA	NA

Example: Africa, 2015

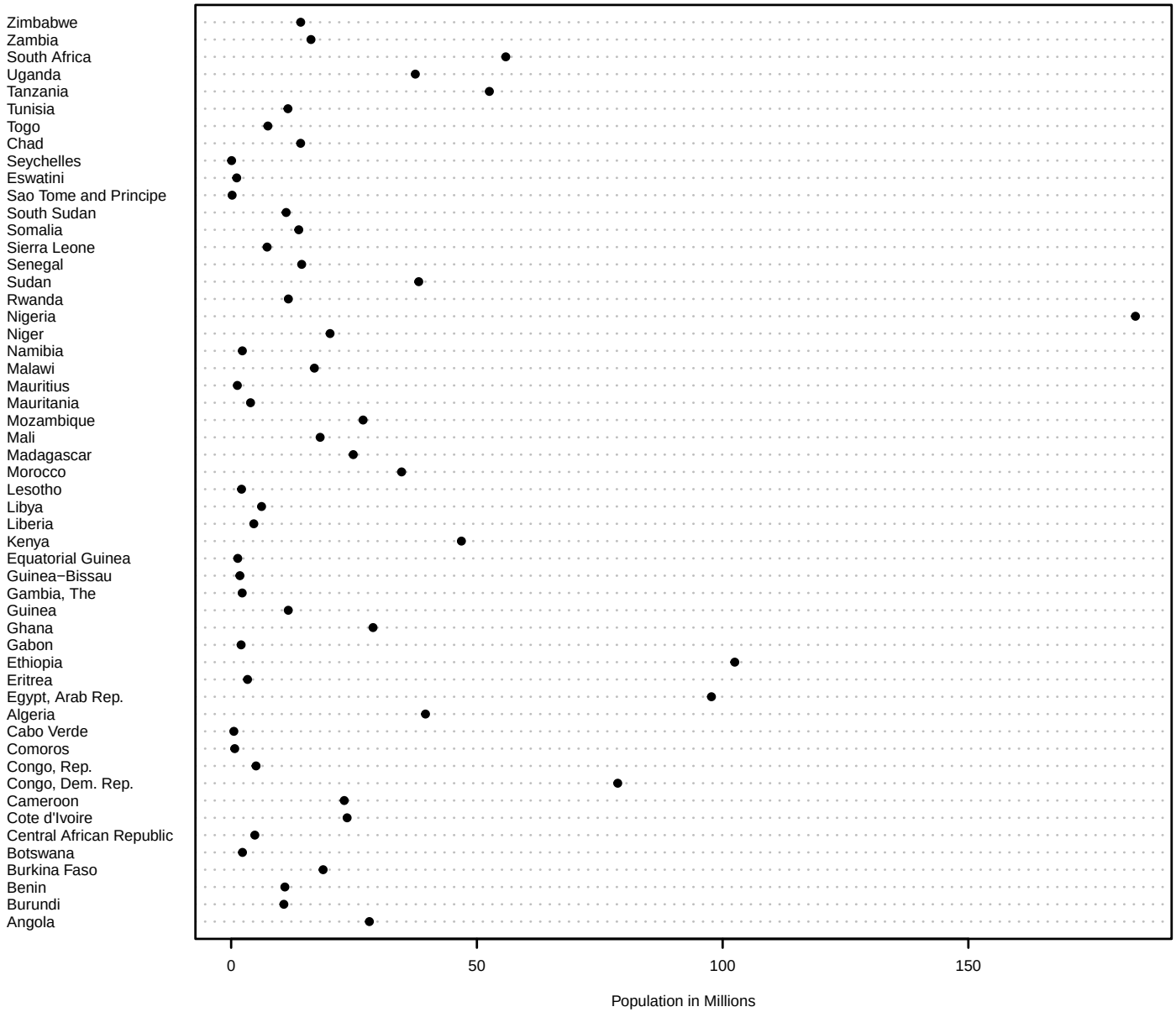
```
> summary(Africa)

     ISO3              Country            Capital            Longitude        Latitude       SubSaharan
 Length:53          Length:53          Length:53          Min.   :-23.5   Min.   :-29.5   Min.   :0.000
 Class :character   Class :character   Class :character   1st Qu.:  1.2   1st Qu.: -6.2   1st Qu.:1.000
 Mode  :character   Mode  :character   Mode  :character   Median : 15.3   Median :  4.8   Median :1.000
                                                           Mean   : 16.1   Mean   :  2.3   Mean   :0.906
                                                           3rd Qu.: 31.6   3rd Qu.: 12.4   3rd Qu.:1.000
                                                           Max.   : 57.5   Max.   : 36.8   Max.   :1.000

   Population        PopulationDensity VDEMDemocracy   POLITYDemocracy ConflictOnset   HIVPrevalence
 Min.   :    93419   Min.   :  3       Min.   :0.070   Min.   :-9.00   Min.   :0.000   Min.   : 0.10
 1st Qu.:  3340006   1st Qu.: 22       1st Qu.:0.282   1st Qu.:-2.00   1st Qu.:0.000   1st Qu.: 0.70
 Median : 11642959   Median : 59       Median :0.454   Median : 4.00   Median :0.000   Median : 1.80
 Mean   : 22611250   Mean   : 99       Mean   :0.439   Mean   : 2.59   Mean   :0.176   Mean   : 4.68
 3rd Qu.: 26843246   3rd Qu.:101       3rd Qu.:0.593   3rd Qu.: 7.00   3rd Qu.:0.000   3rd Qu.: 4.90
 Max.   :183995785   Max.   :632       Max.   :0.844   Max.   :10.00   Max.   :1.000   Max.   :29.90
                                       NA's   :2       NA's   :2       NA's   :2       NA's   :4
 AdFertilityRate HomicidesPer100K PropWomenInParliament  LiteracyRate    GINIIndex
 Min.   :  7.6   Min.   : 0.3     Min.   : 3.0          Min.   :26.0   Min.   :31.8
 1st Qu.: 70.7   1st Qu.: 1.7     1st Qu.:11.3          1st Qu.:52.1   1st Qu.:35.9
 Median : 96.0   Median : 3.7     Median :18.2          Median :62.9   Median :41.5
 Mean   : 96.7   Mean   : 5.3     Mean   :21.9          Mean   :64.4   Mean   :42.7
 3rd Qu.:127.9   3rd Qu.: 6.2     3rd Qu.:31.4          3rd Qu.:84.6   3rd Qu.:47.8
 Max.   :177.0   Max.   :33.4     Max.   :63.8          Max.   :94.4   Max.   :59.1
                 NA's   :34       NA's   :2             NA's   :43     NA's   :40
```

A Better (?) Summary

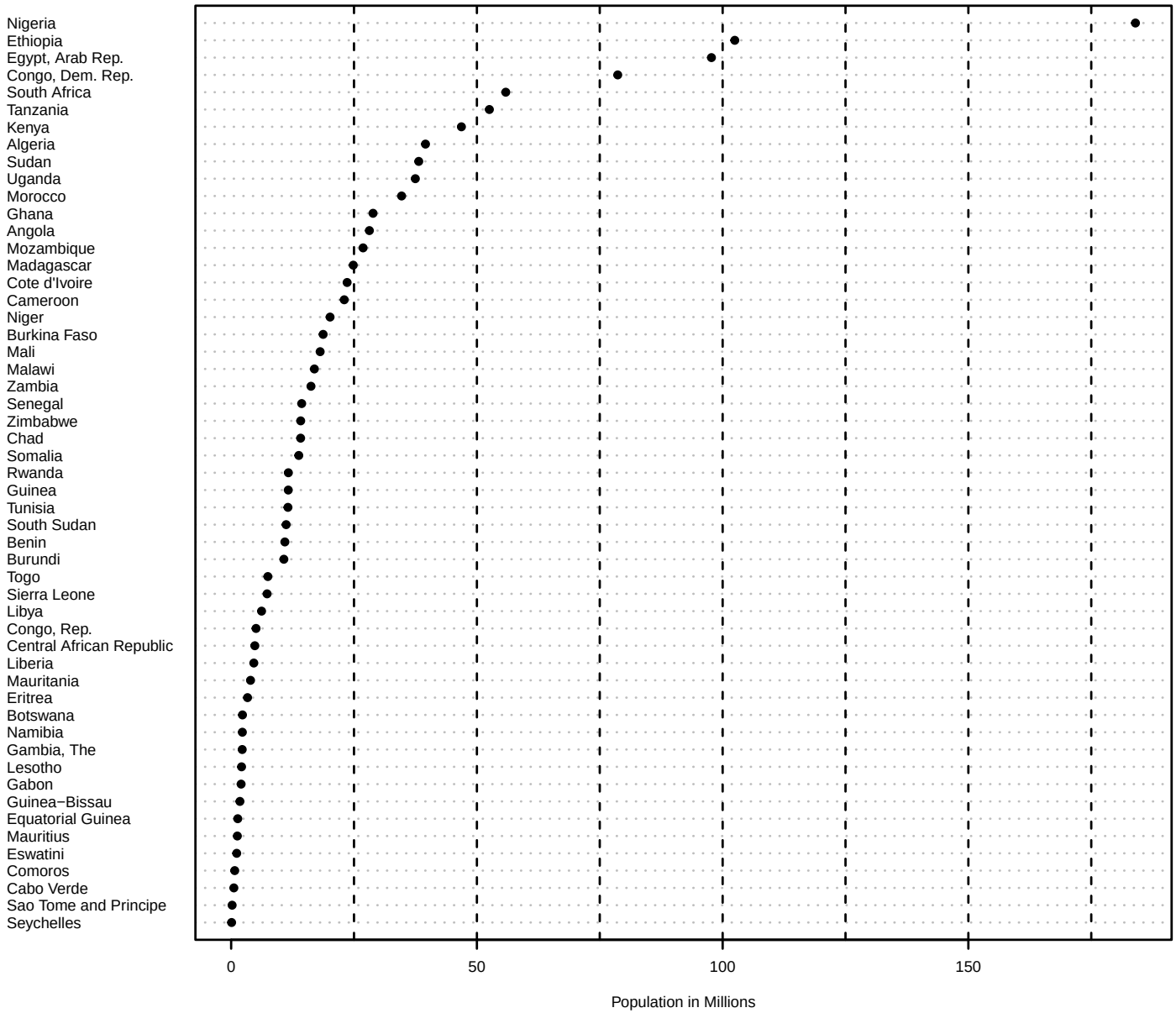
```
> describe(Africa,skew=FALSE)
```

	vars	n	mean	sd	median	min	max	range	se
ISO3*	1	53	27.00	15.44	27.00	1.00	53.00	52.00	2.12
Country*	2	53	27.00	15.44	27.00	1.00	53.00	52.00	2.12
Capital*	3	53	27.00	15.44	27.00	1.00	53.00	52.00	2.12
Longitude	4	53	16.06	20.56	15.27	-23.51	57.50	81.01	2.82
Latitude	5	53	2.33	16.59	4.85	-29.52	36.79	66.31	2.28
SubSaharan	6	53	0.91	0.30	1.00	0.00	1.00	1.00	0.04
Population	7	53	22611249.51	32291310.26	11642959.00	93419.00	183995785.00	183902366.00	4435552.59
PopulationDensity	8	53	98.84	127.05	59.32	2.77	632.39	629.62	17.45
VDEMDemocracy	9	51	0.44	0.20	0.45	0.07	0.84	0.77	0.03
POLITYDemocracy	10	51	2.59	5.13	4.00	-9.00	10.00	19.00	0.72
ConflictOnset	11	51	0.18	0.39	0.00	0.00	1.00	1.00	0.05
HIVPrevalence	12	49	4.68	6.82	1.80	0.10	29.90	29.80	0.97
AdFertilityRate	13	53	96.75	42.40	95.99	7.62	177.00	169.39	5.82
HomicidesPer100K	14	19	5.33	7.34	3.74	0.27	33.42	33.15	1.68
PropWomenInParliament	15	51	21.89	13.08	18.18	3.03	63.75	60.72	1.83
LiteracyRate	16	10	64.35	23.80	62.94	26.00	94.37	68.36	7.53
GINIIndex	17	13	42.72	8.92	41.50	31.80	59.10	27.30	2.47

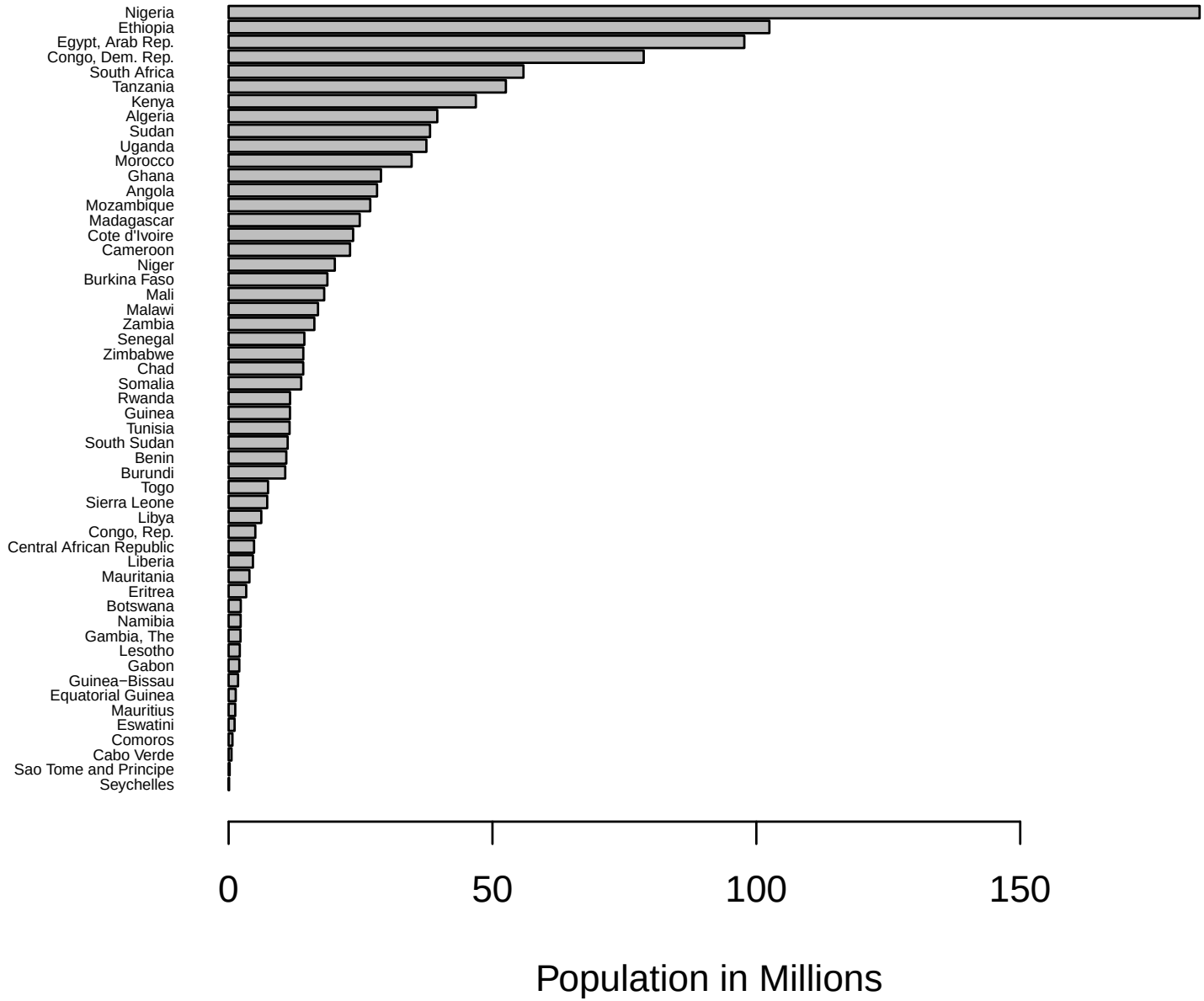
The Dotchart



The Dotchart, Sorted

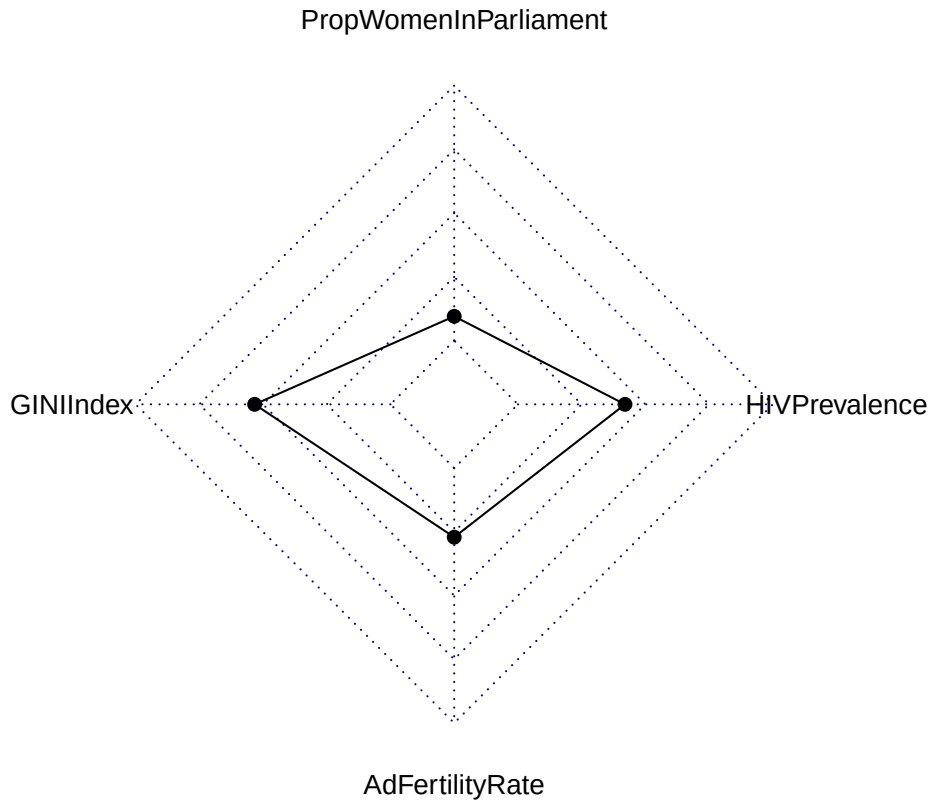


The Barchart, Sorted



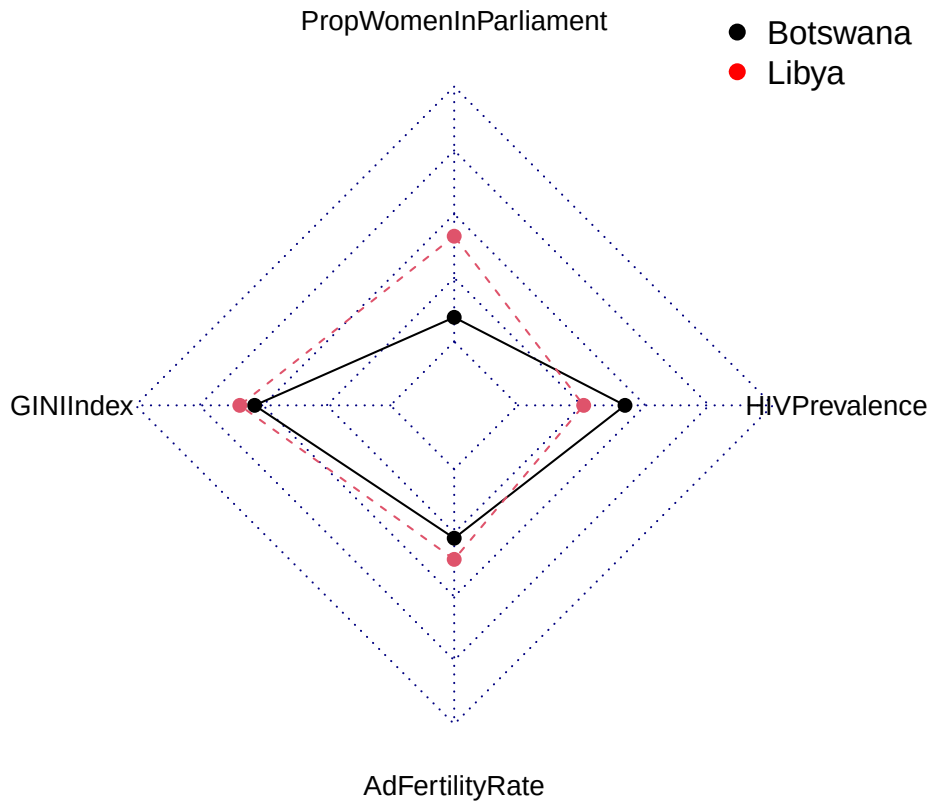
“Spiderplots” / Radar Plots / etc.

Radar Chart: Botswana



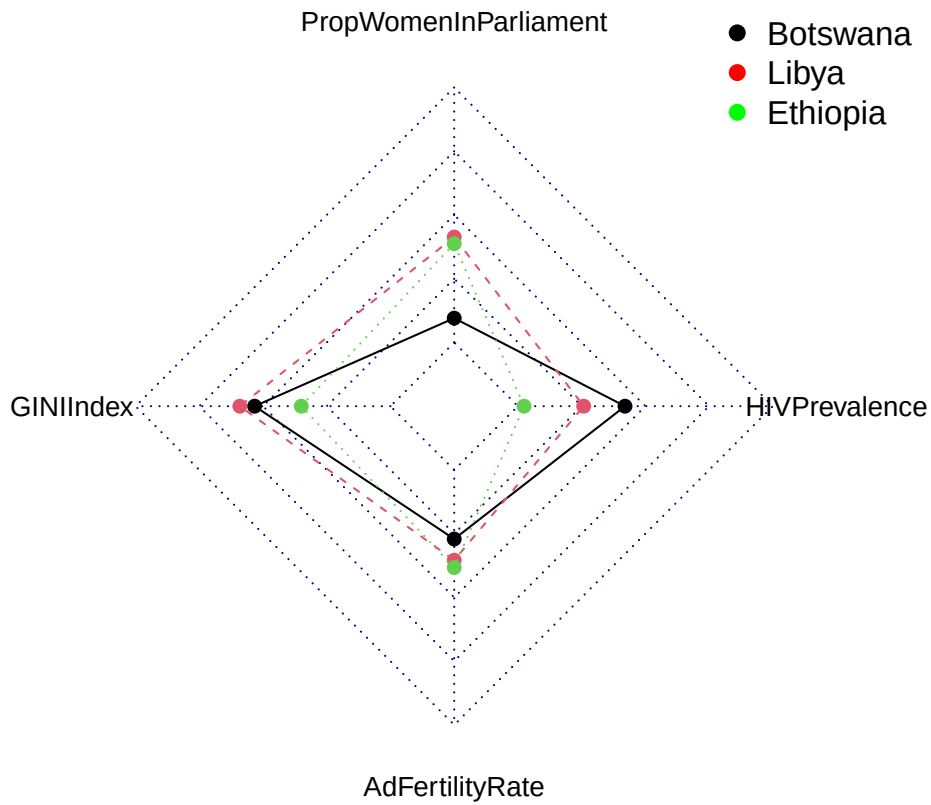
“Spiderplots” / Radar Plots / etc. (cont’d)

Radar Chart: Botswana and Namibia

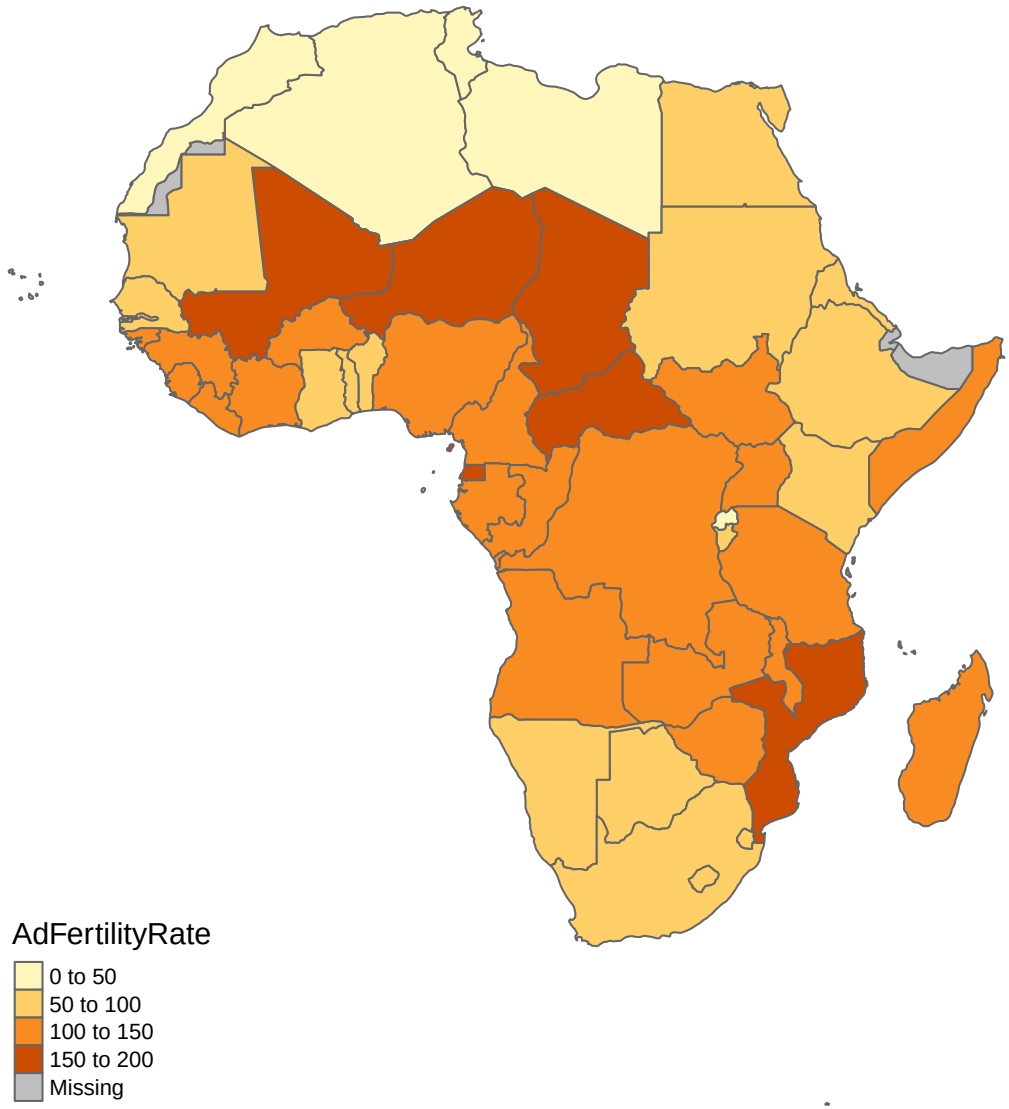


Even More Radar Plots!

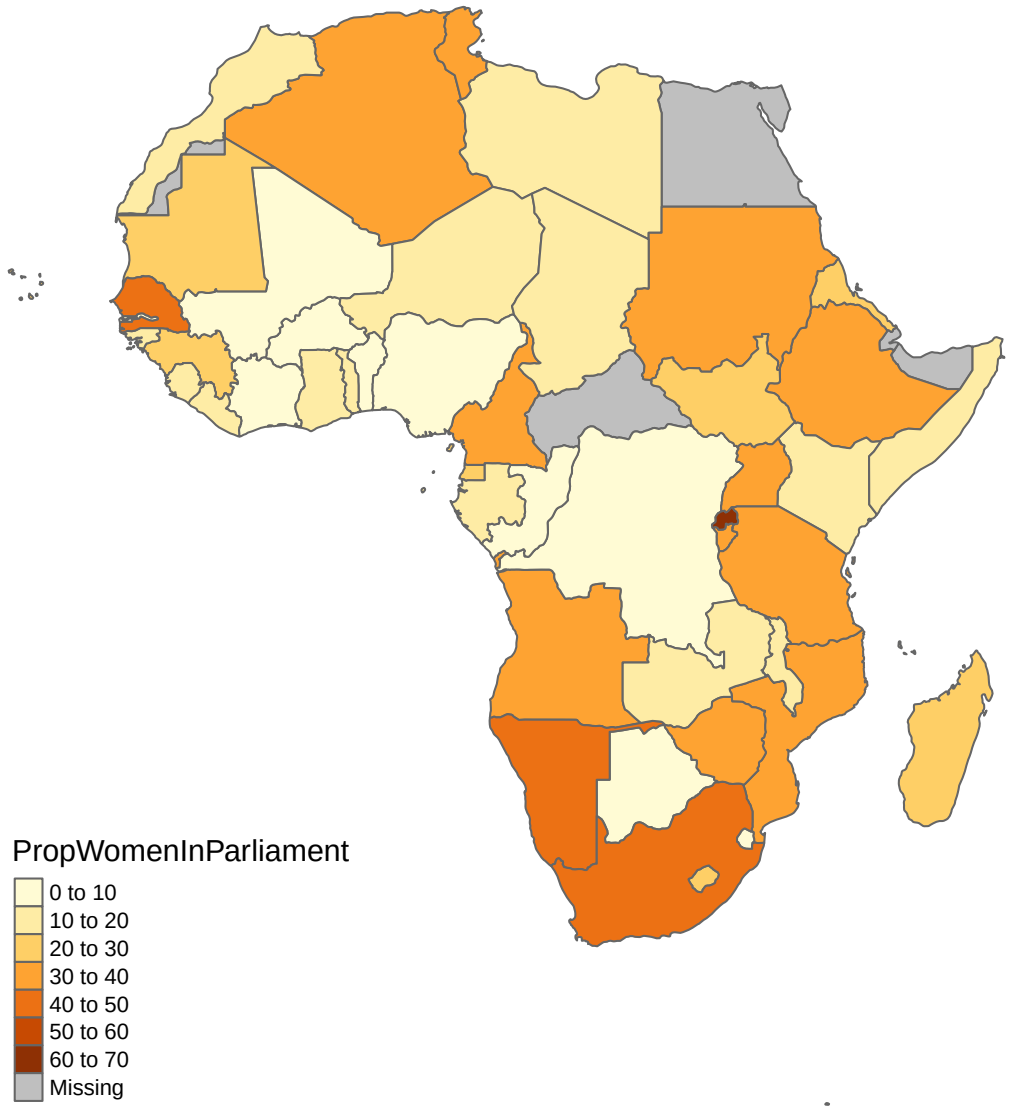
Radar Chart: Botswana, Namibia, and Ethiopia



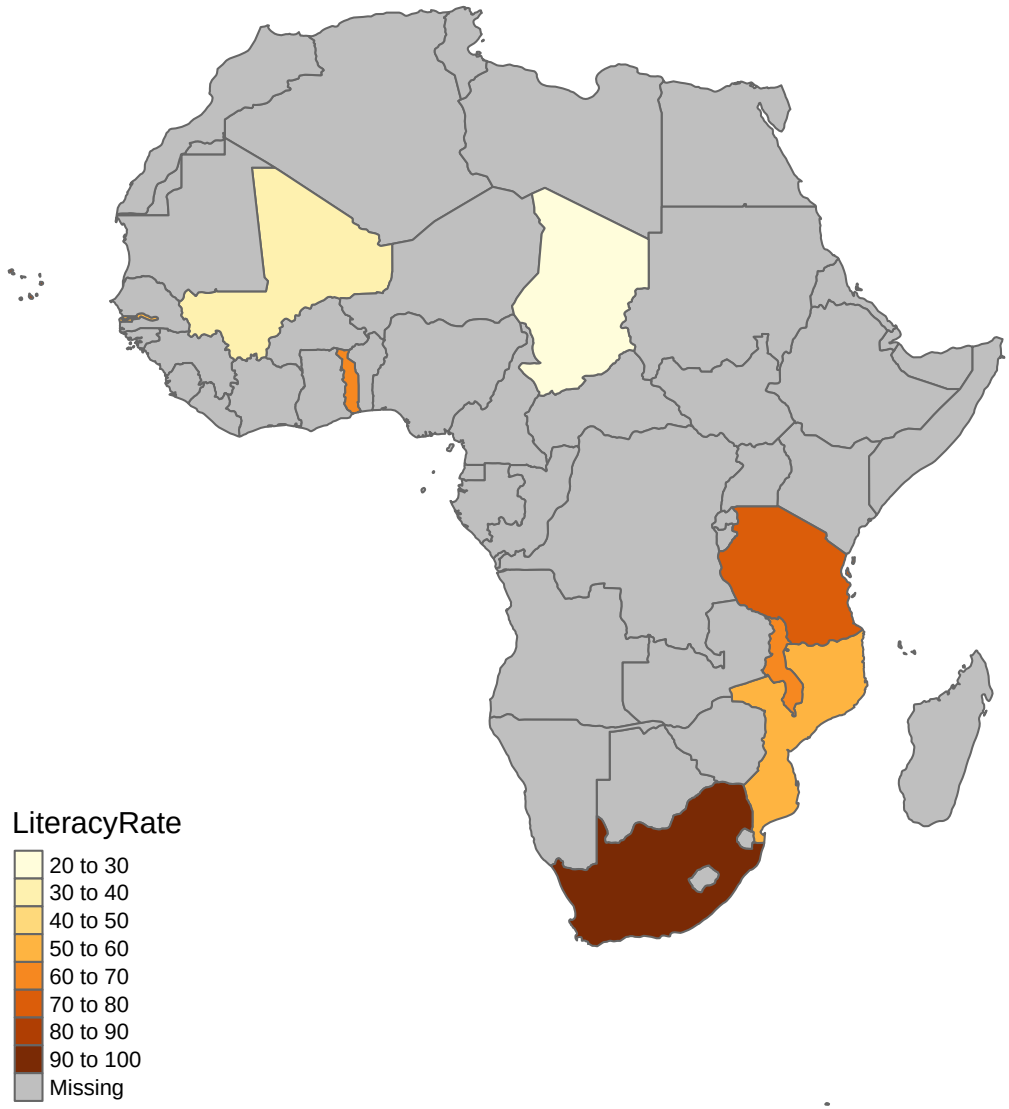
OMG MAPS


AdFertilityRate
0 to 50
50 to 100
100 to 150
150 to 200
Missing

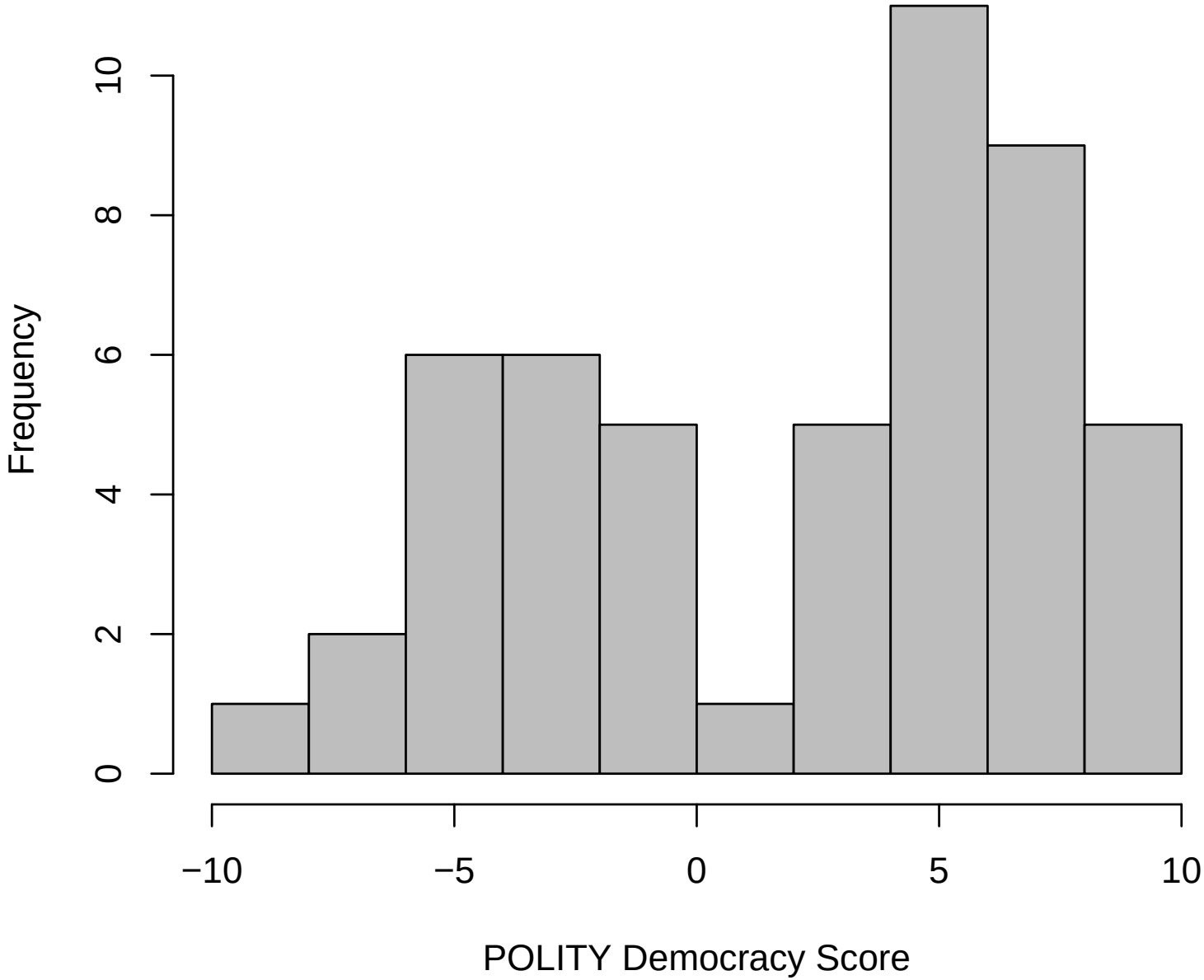
Another One!


PropWomenInParliament
0 to 10
10 to 20
20 to 30
30 to 40
40 to 50
50 to 60
60 to 70
Missing

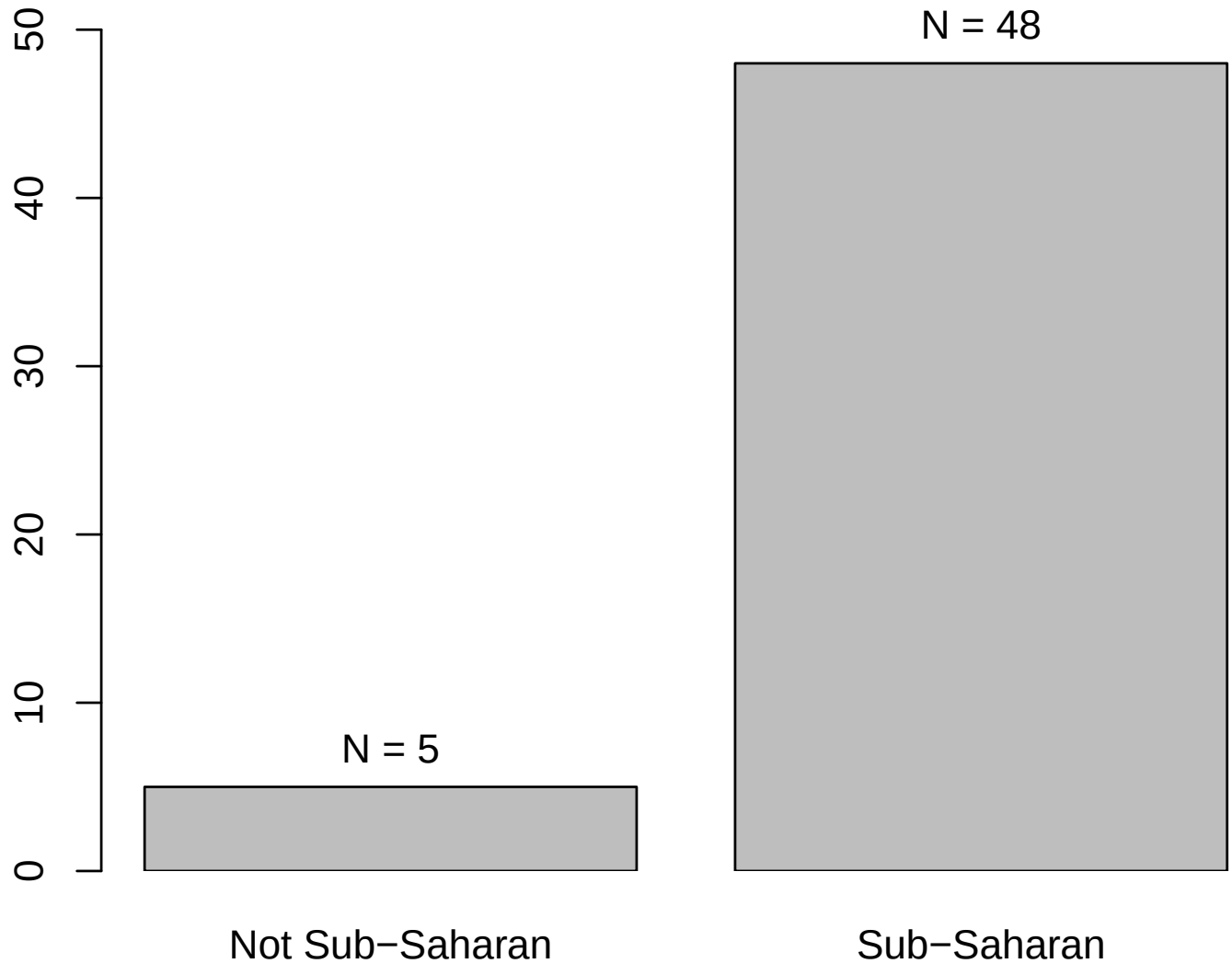
One More (w/lots missing)



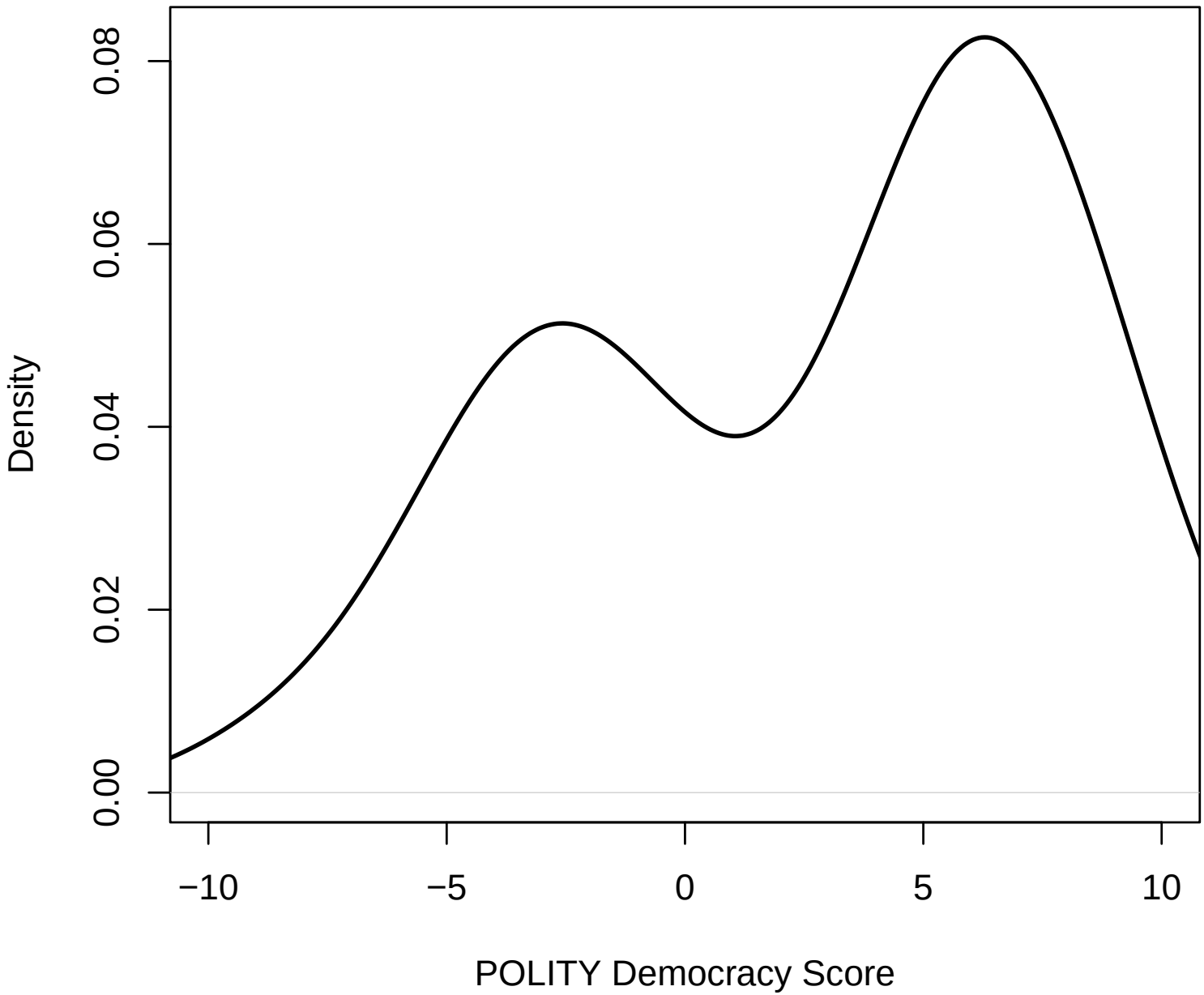
The Histogram



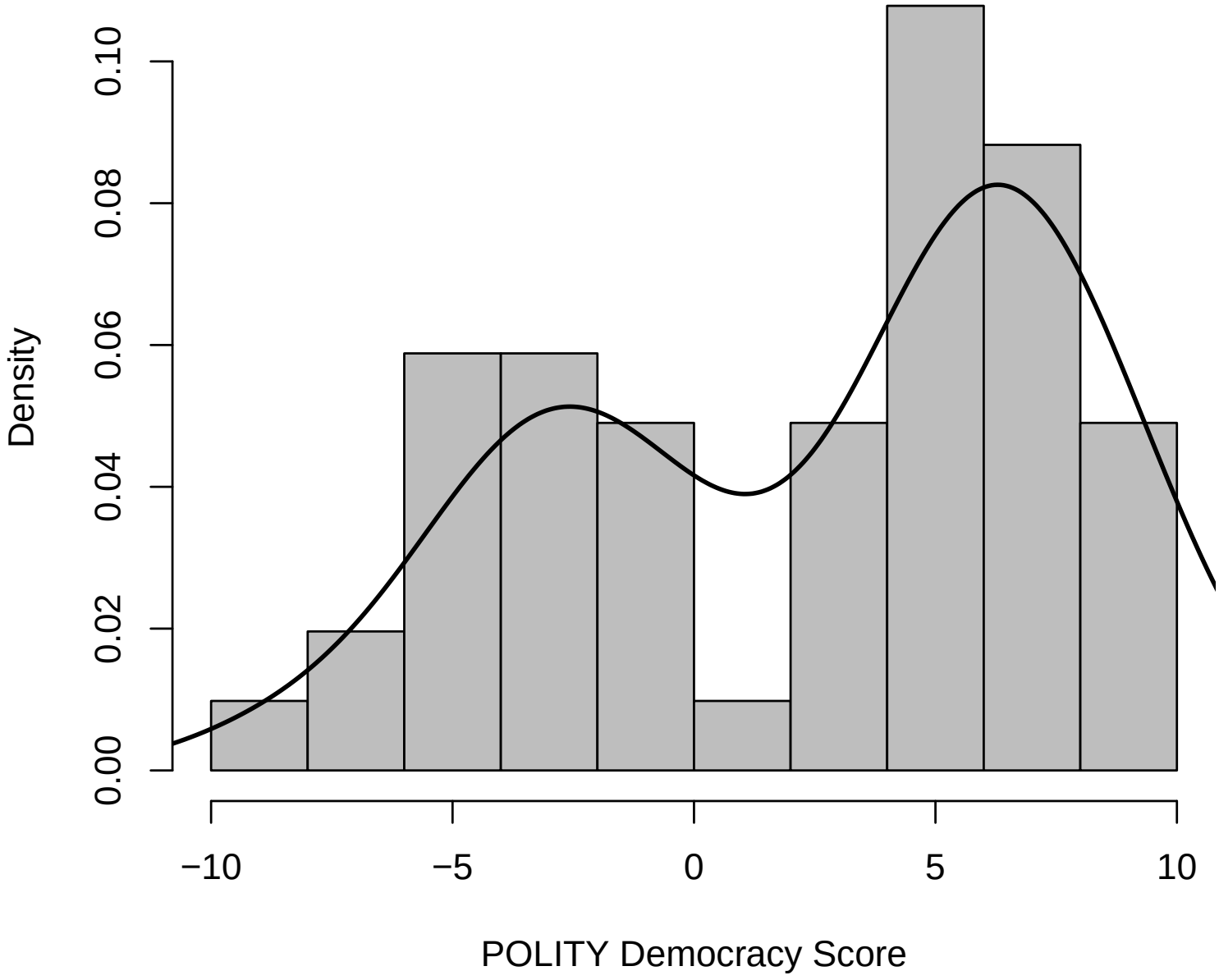
Another Histogram



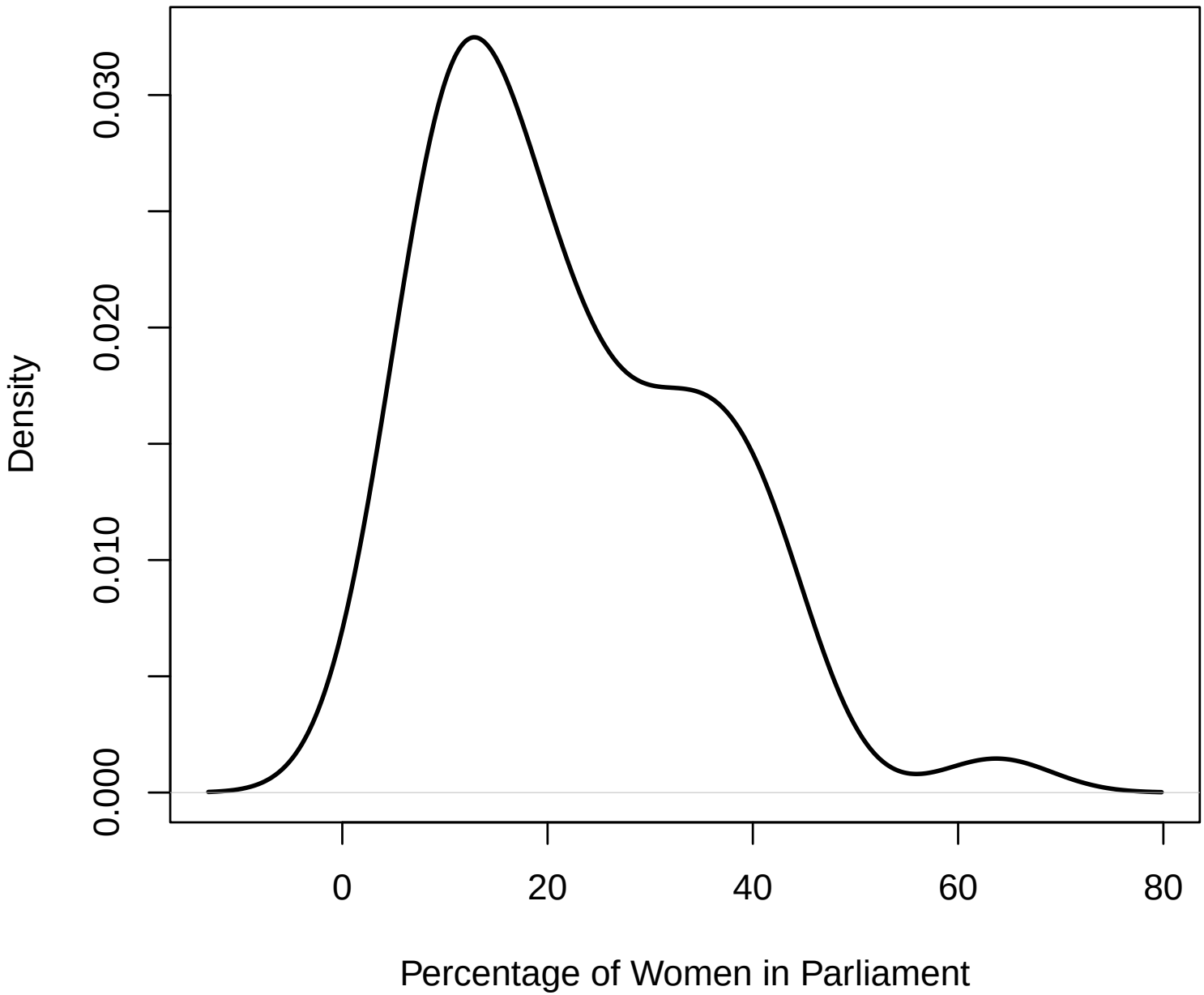
Kernel Density Plot



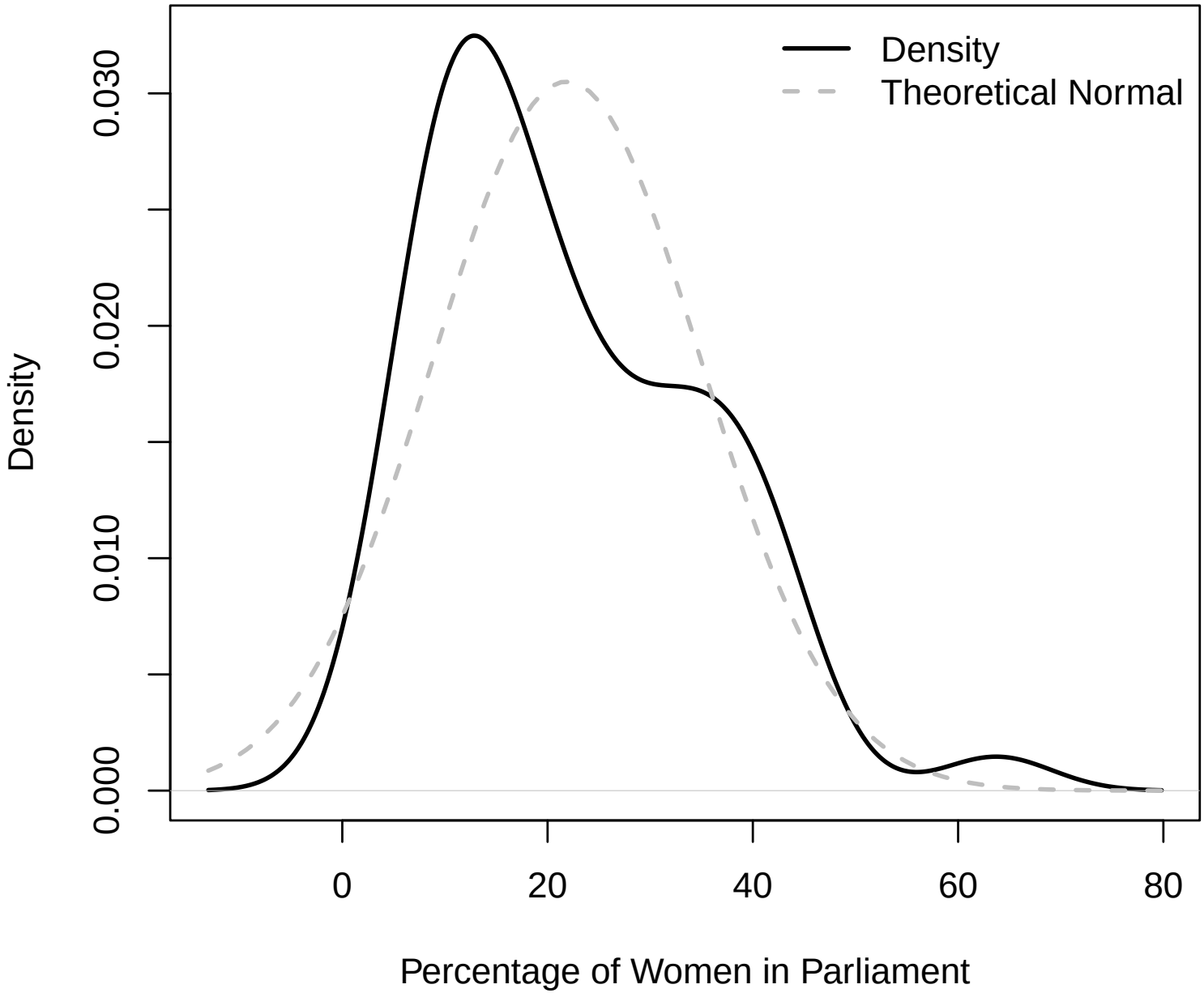
Combined Plot



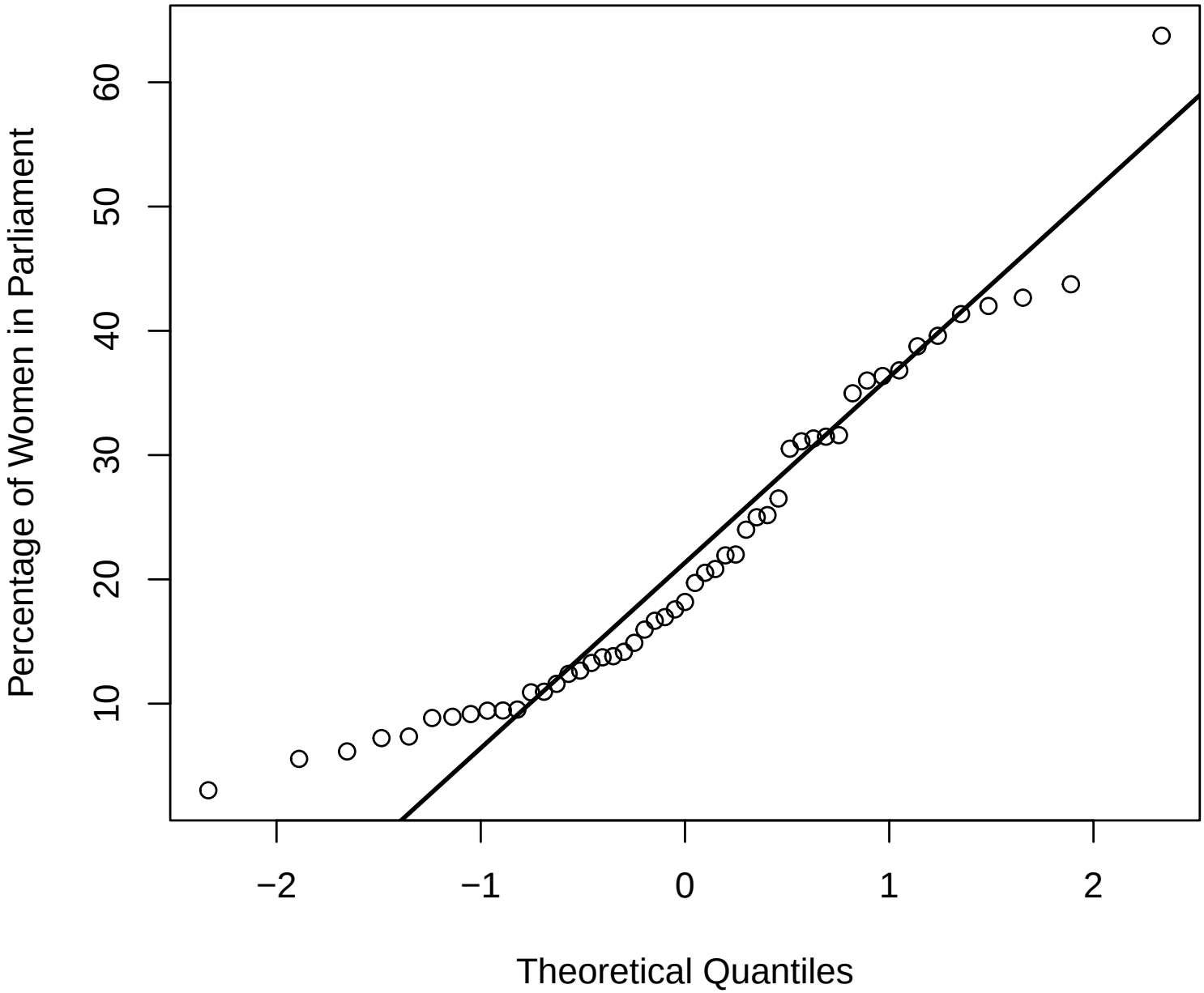
Density Plot: Prop. Women in Parliament



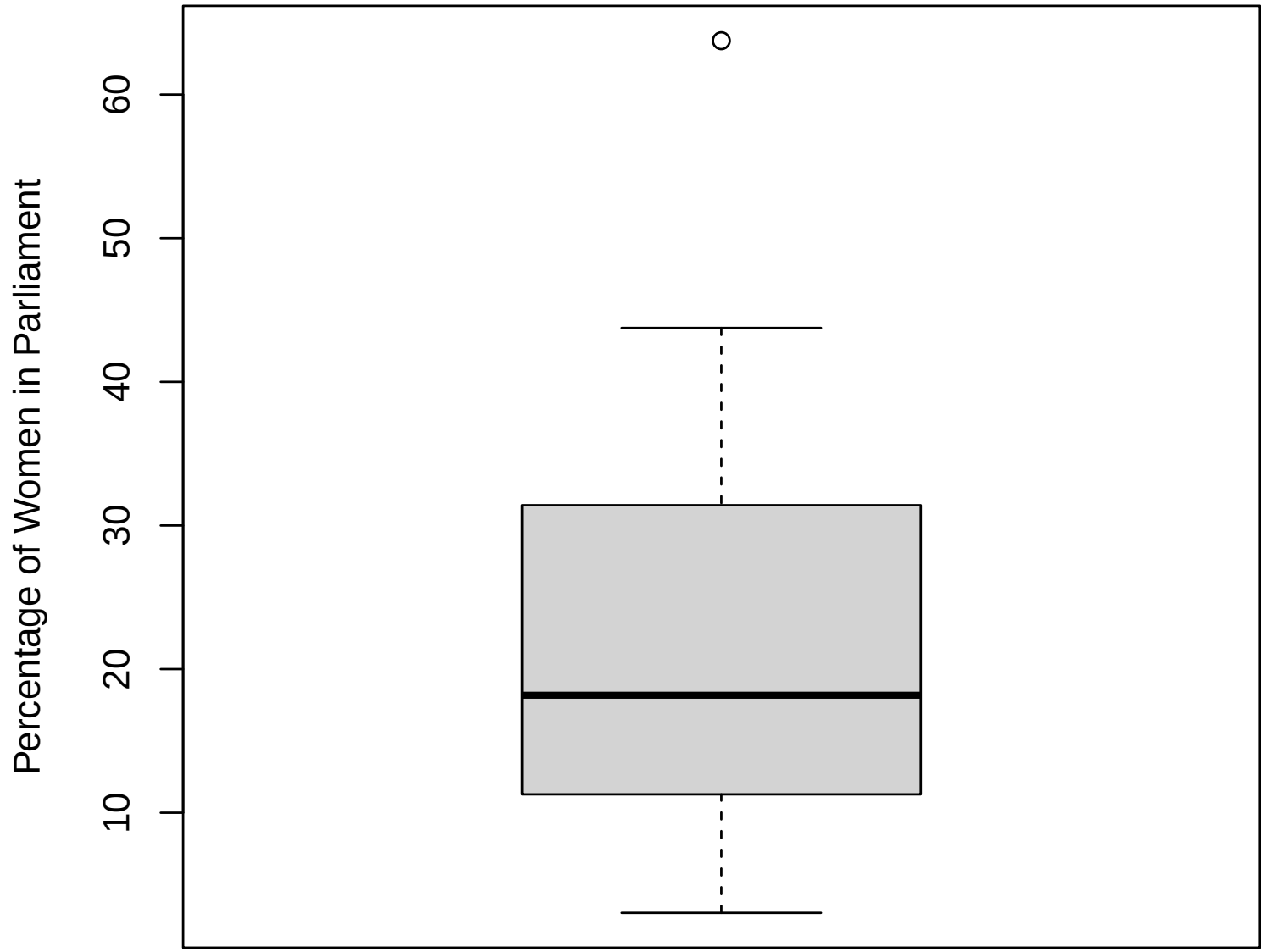
Overlay a Normal Distribution



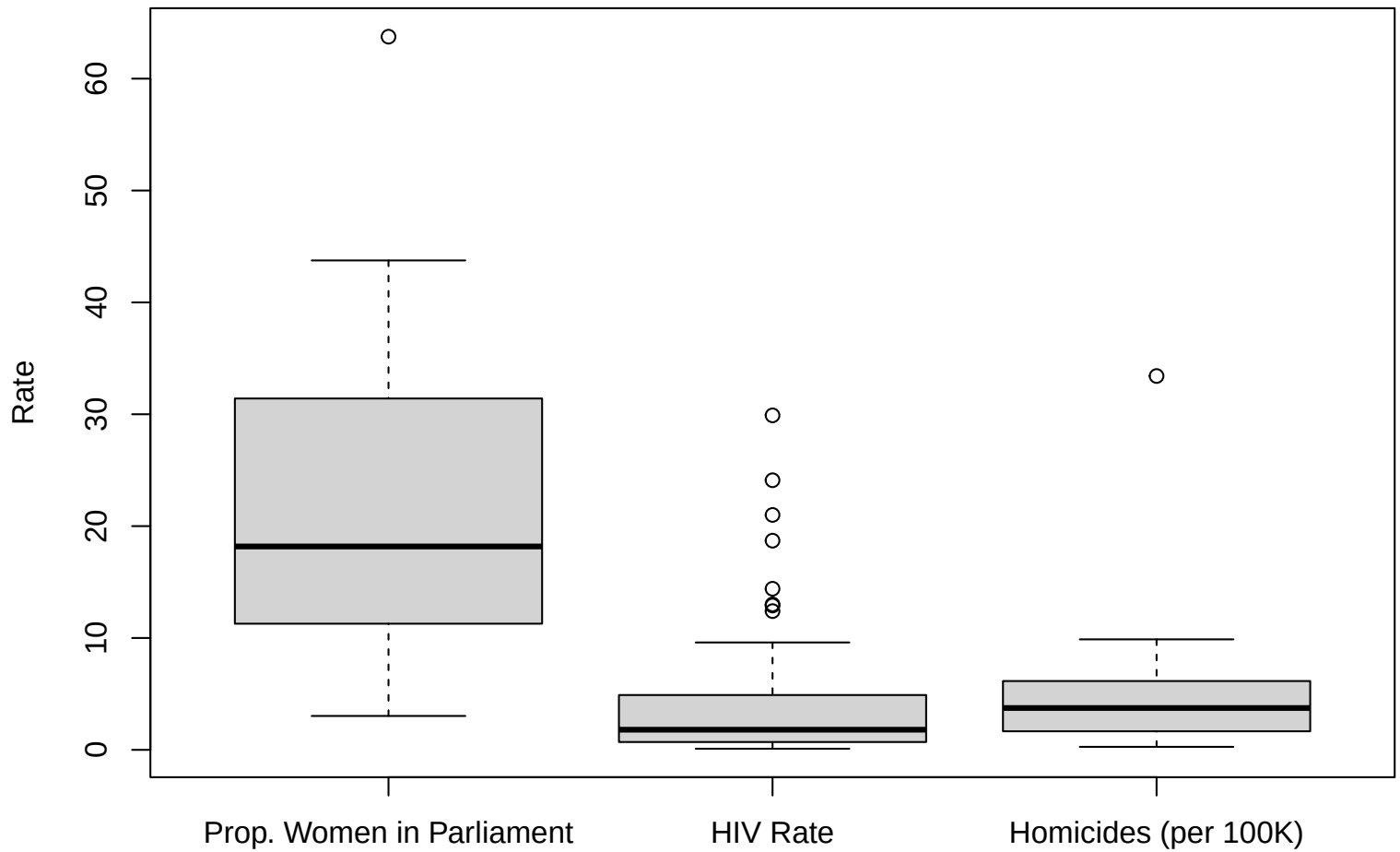
Q-Q Plot: Prop. Women in Parliament



Boxplot: Prop. of Women in Parliament



Boxplot: Women in Parliament, HIV, and Homicides



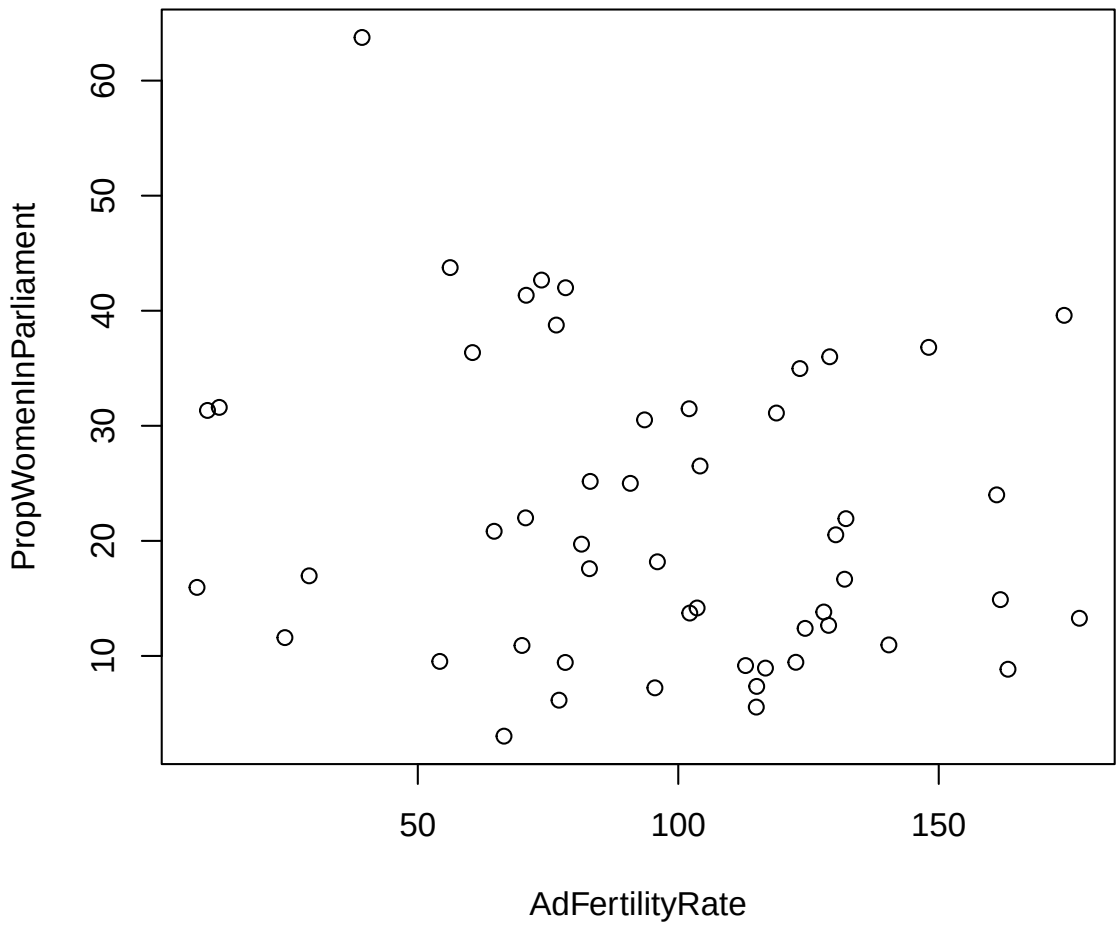
Other Univariate Graphics

- *Stripplots* (or *stripcharts*)
- *Pie charts*
- "Donut" plots
- "Stem and leaf" plots

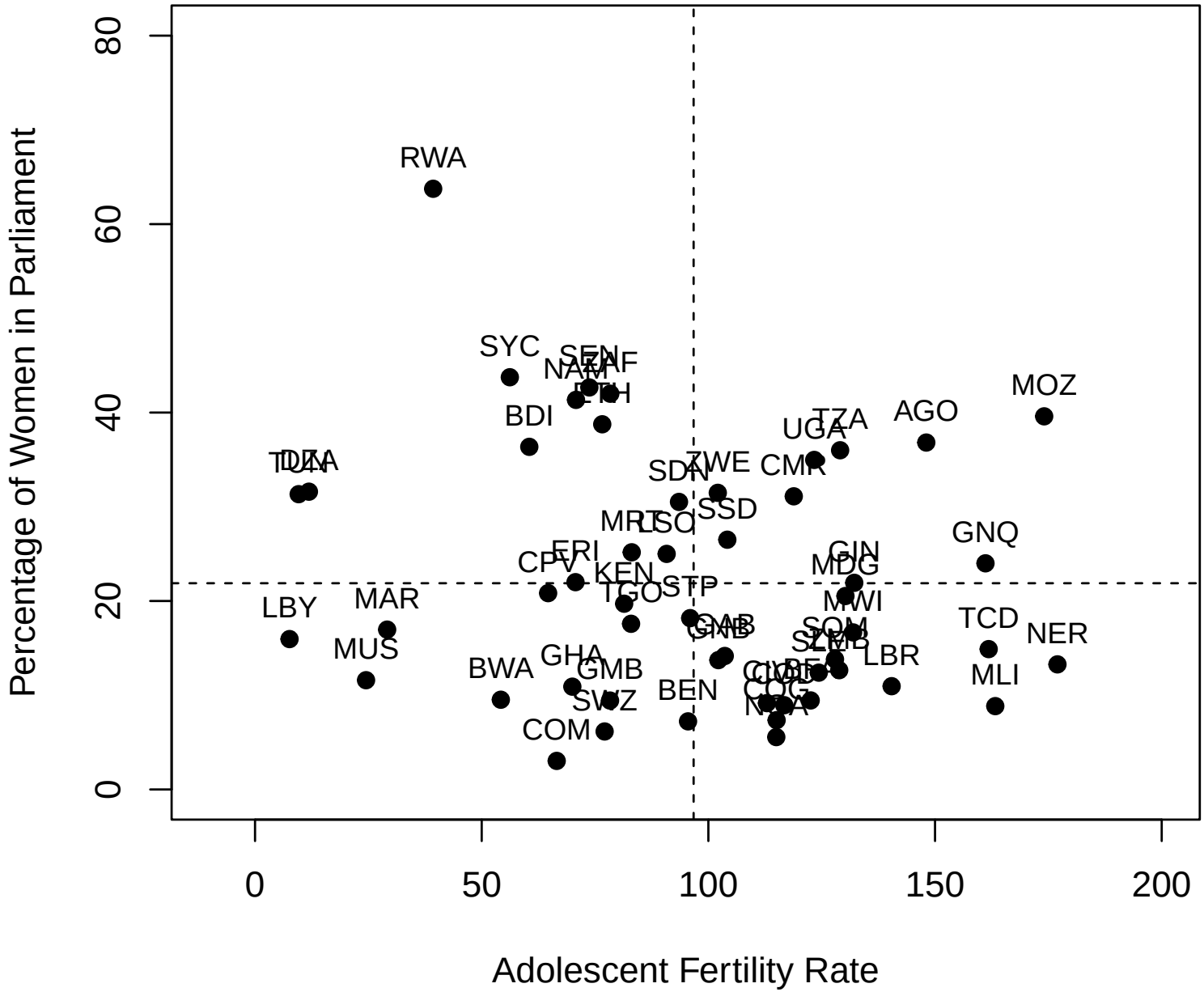
Bivariate and Multivariate Plots

Continuous Data: Scatterplots

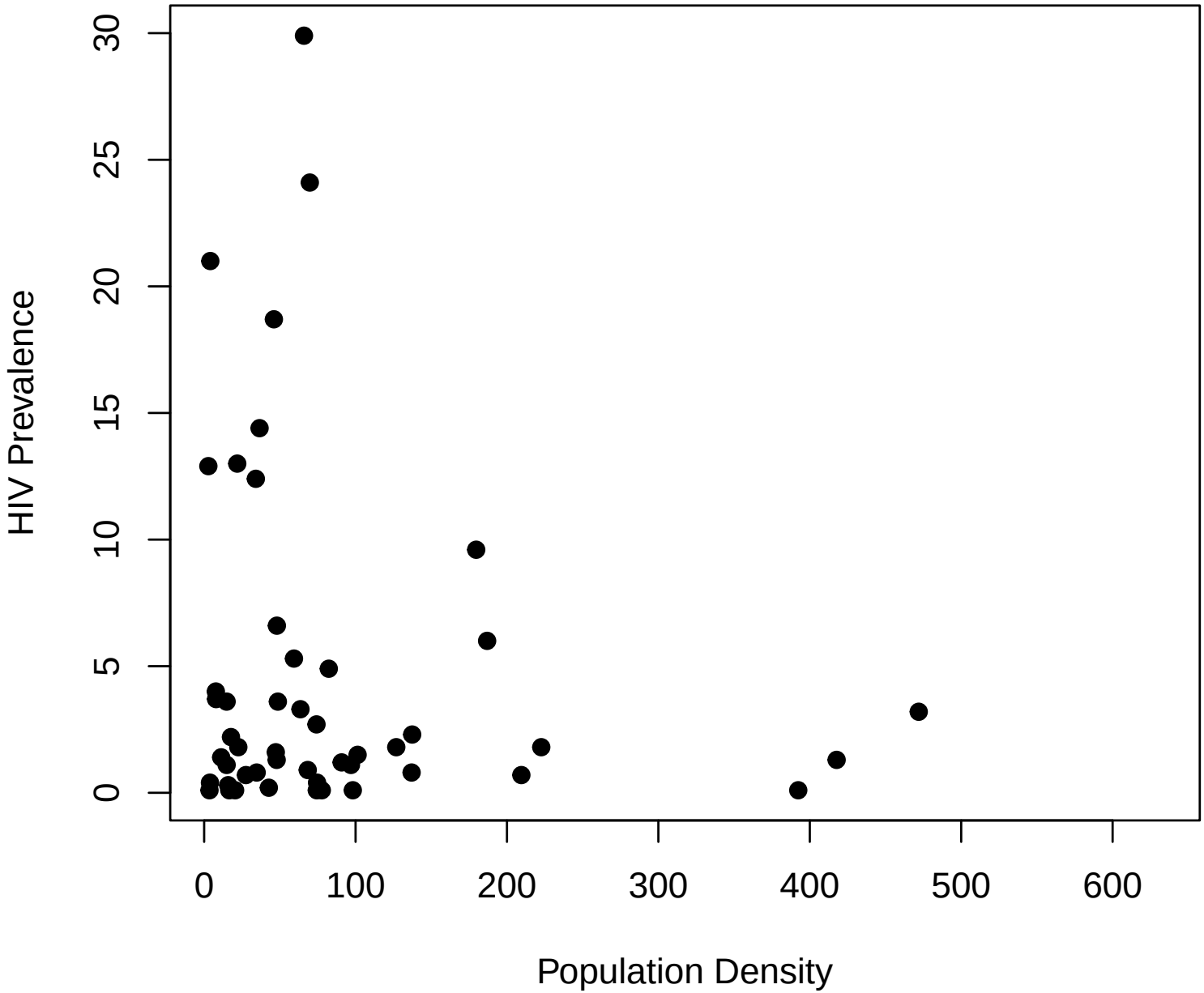
```
> with(Africa, plot(AdFertilityRate,PropWomenInParliament))
```



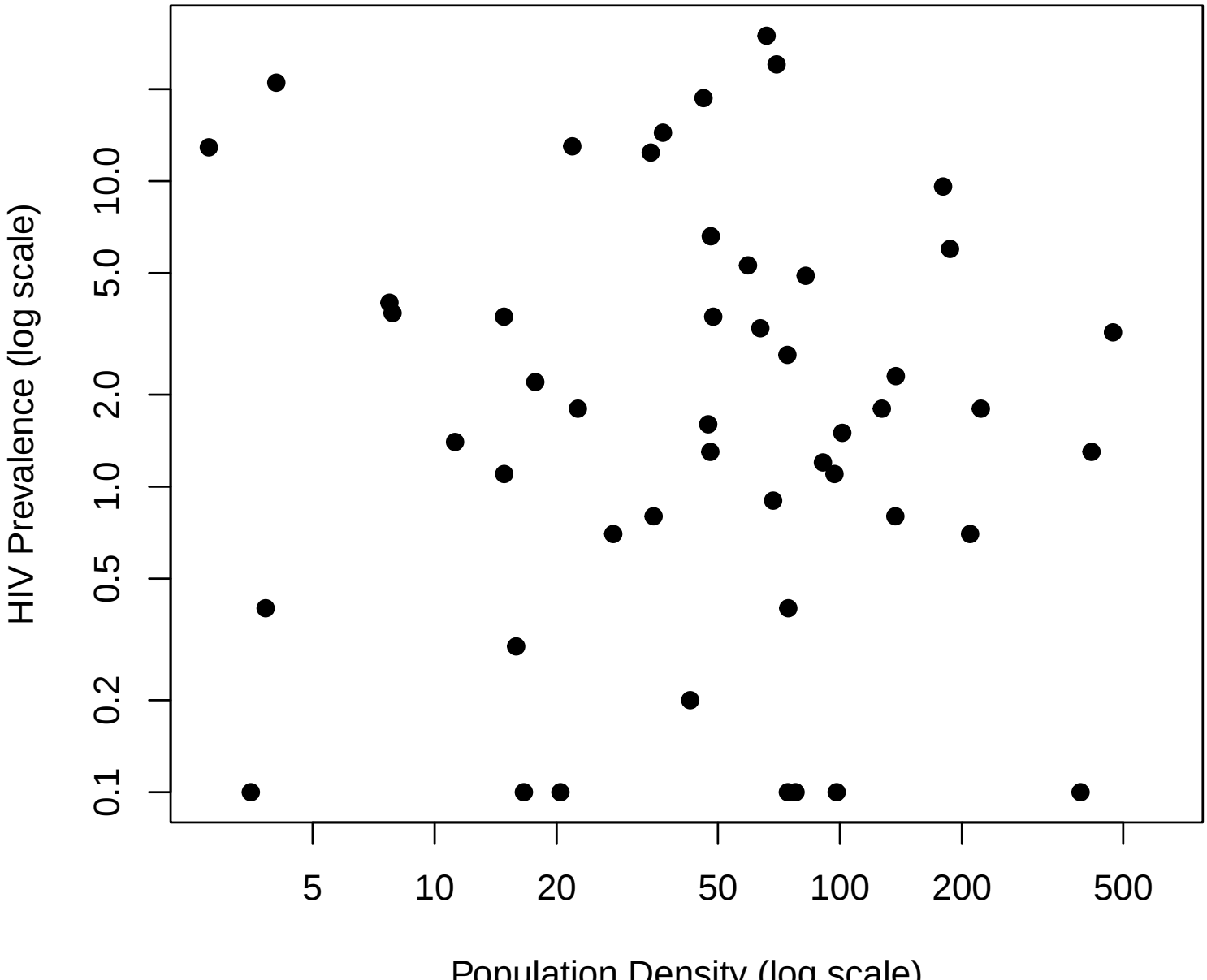
A Better Scatterplot



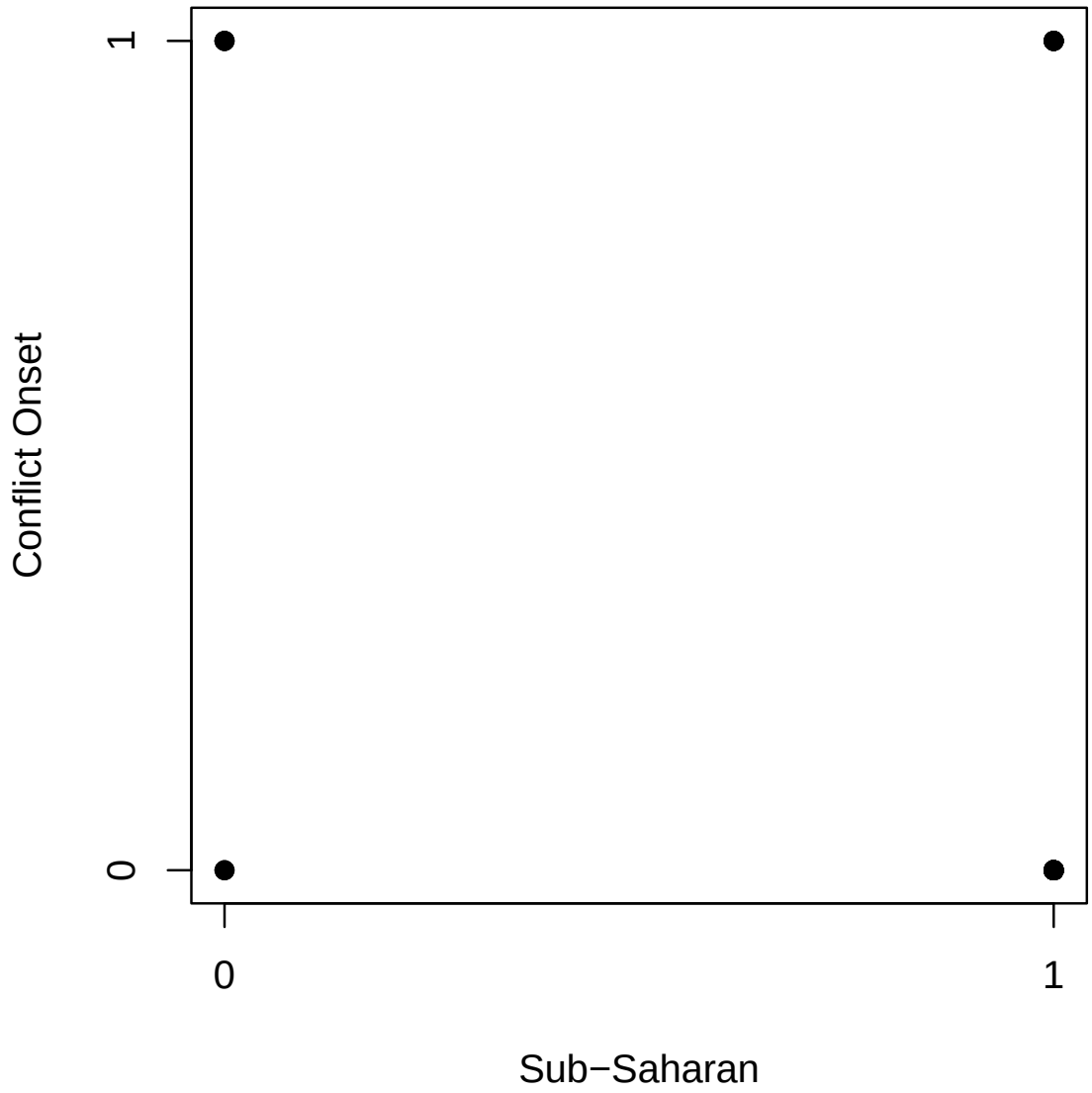
Skewed Data: Trade and GDP



Log-Scale Axes



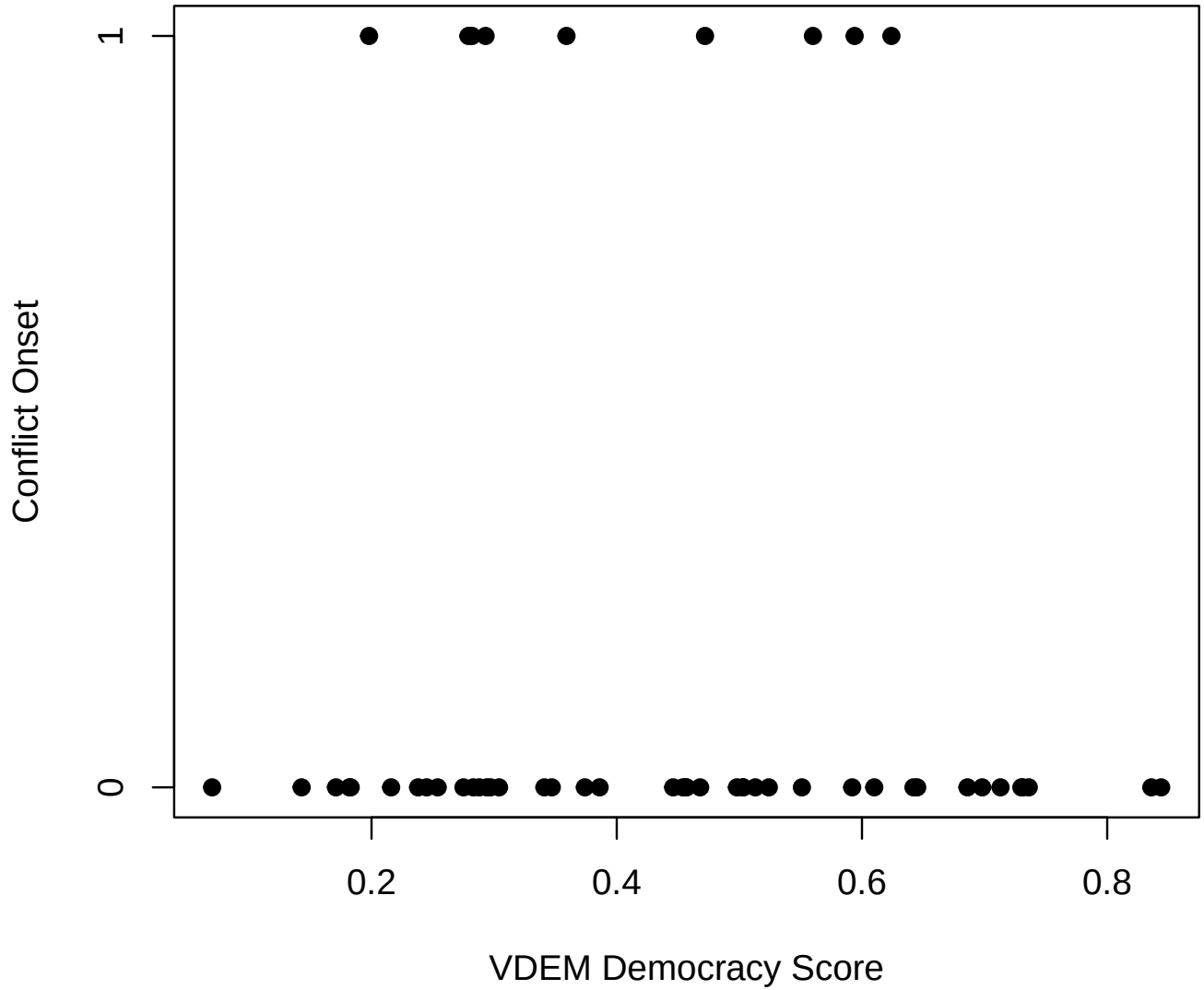
How Not To Draw A Scatterplot



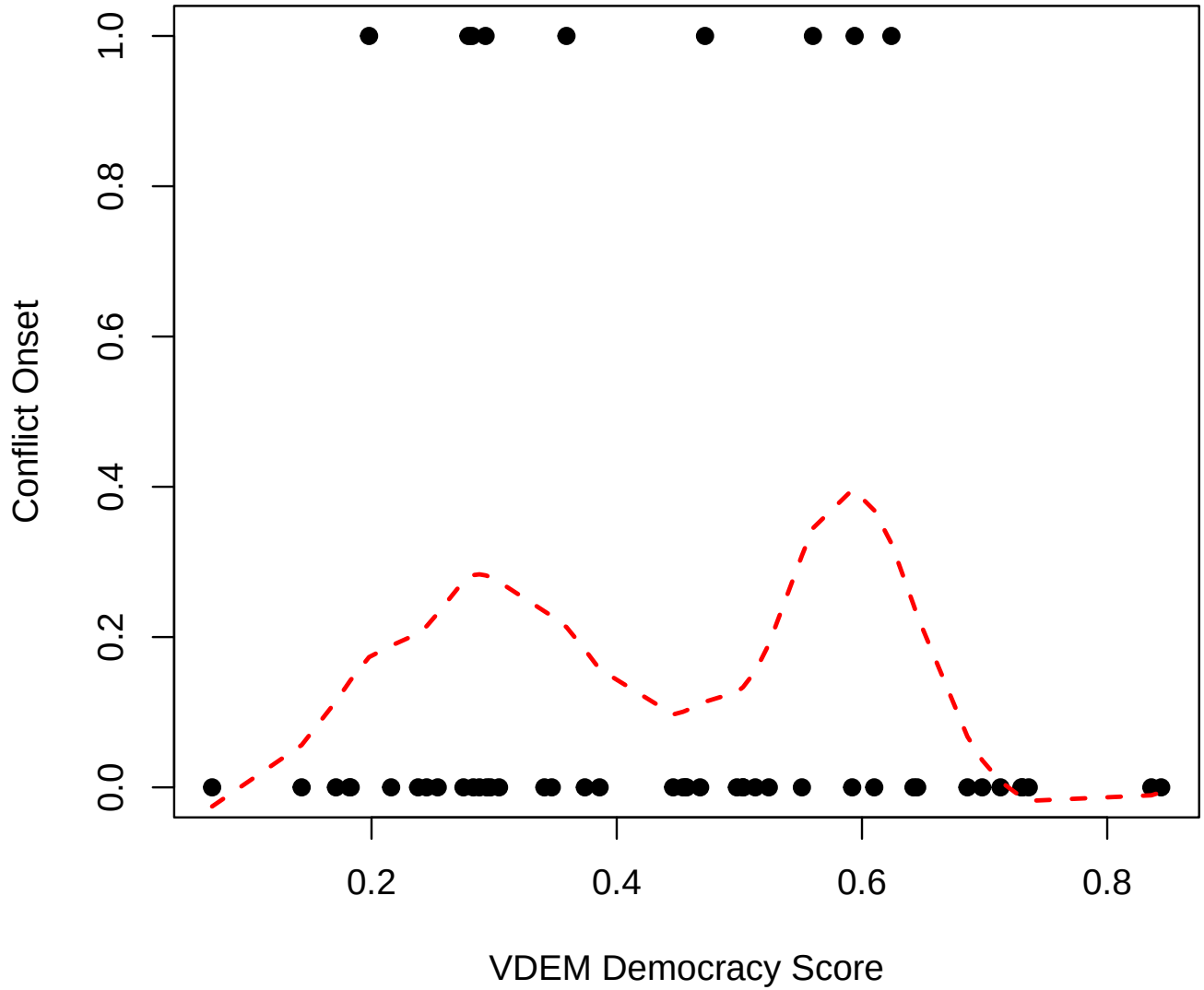
Binary Data = Tables

```
> with(Africa, xtabs(~SubSaharan+ConflictOnset))

           ConflictOnset
SubSaharan  0  1
          0  2  3
          1 40  6
```

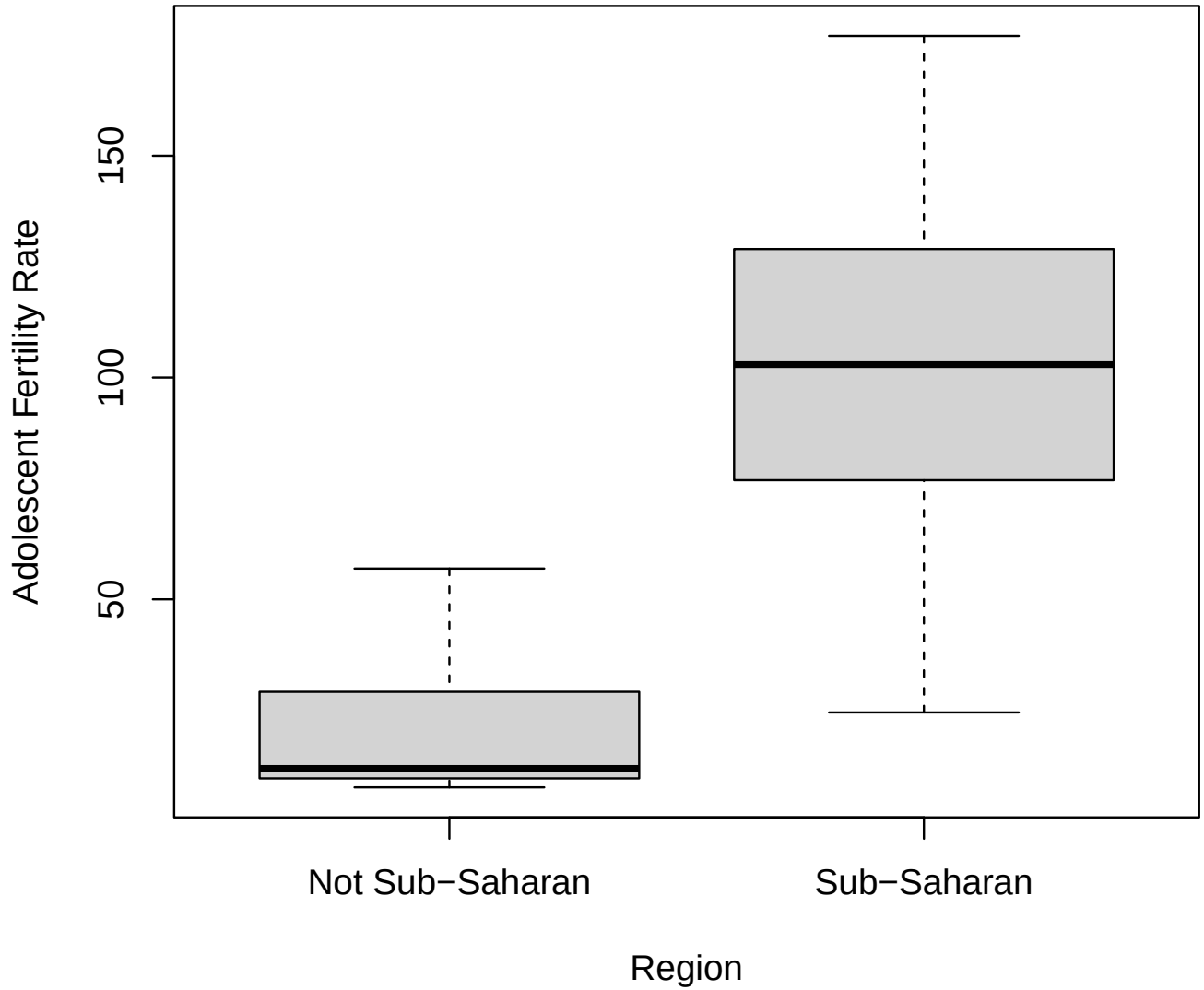
Mixed Binary-Continuous



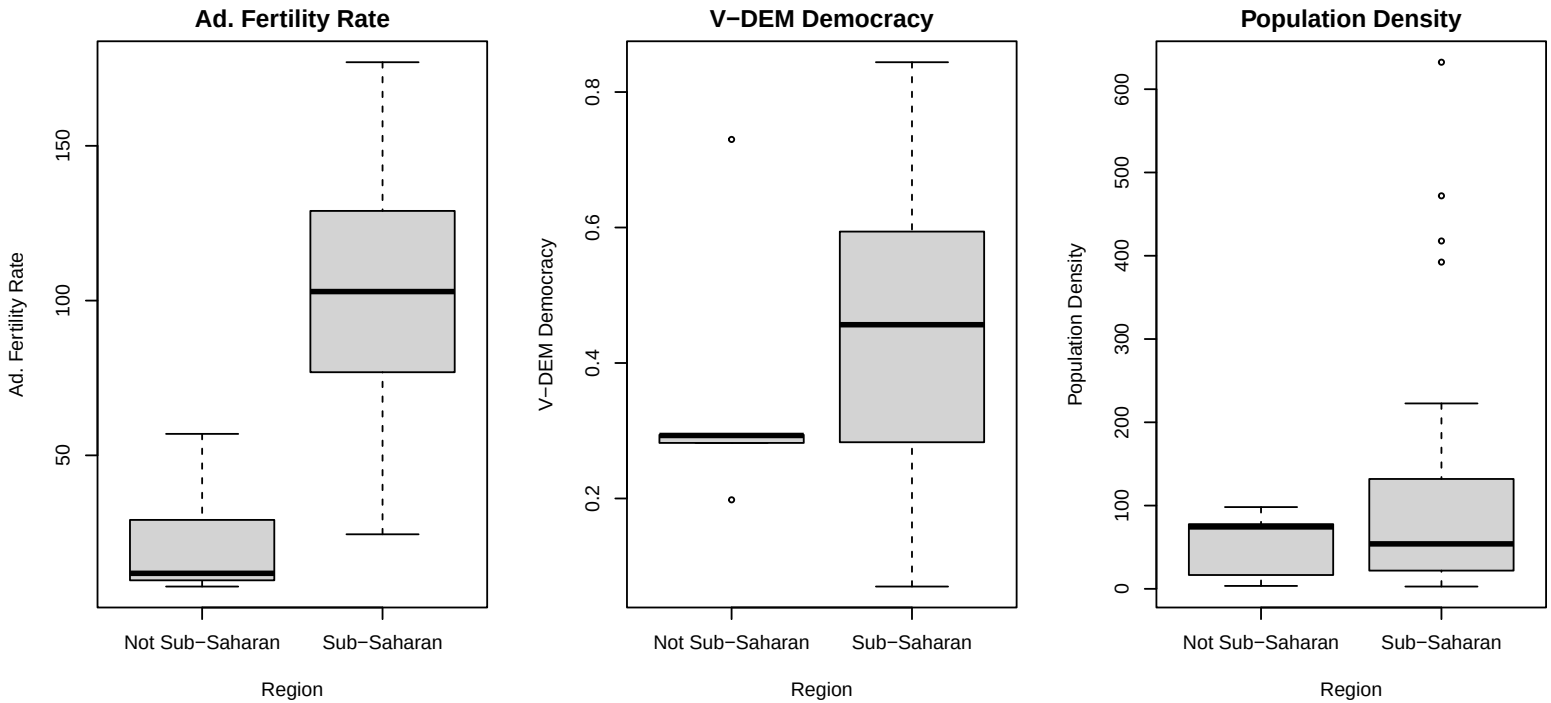
Smoothed Plot



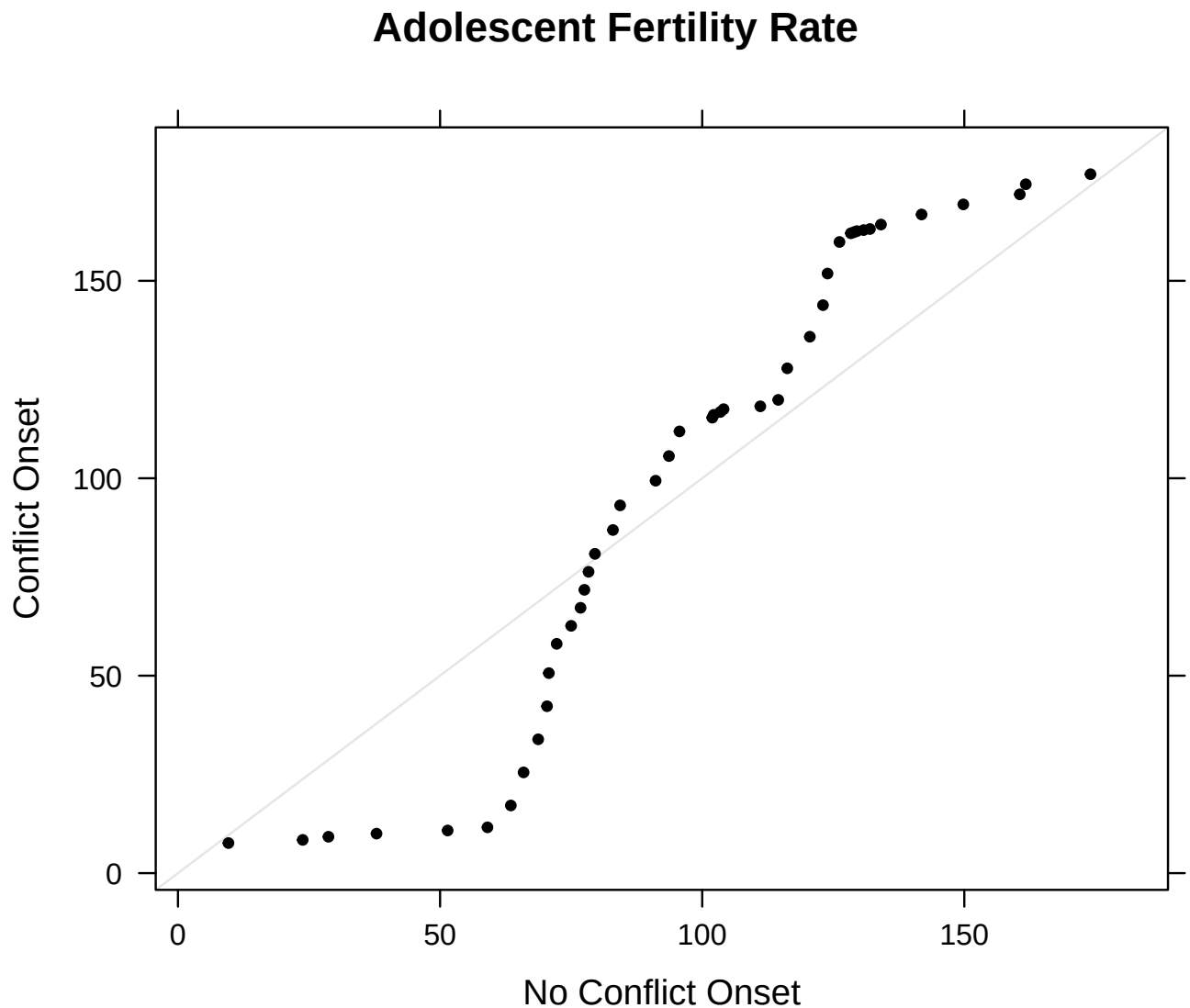
Conditioned Boxplots



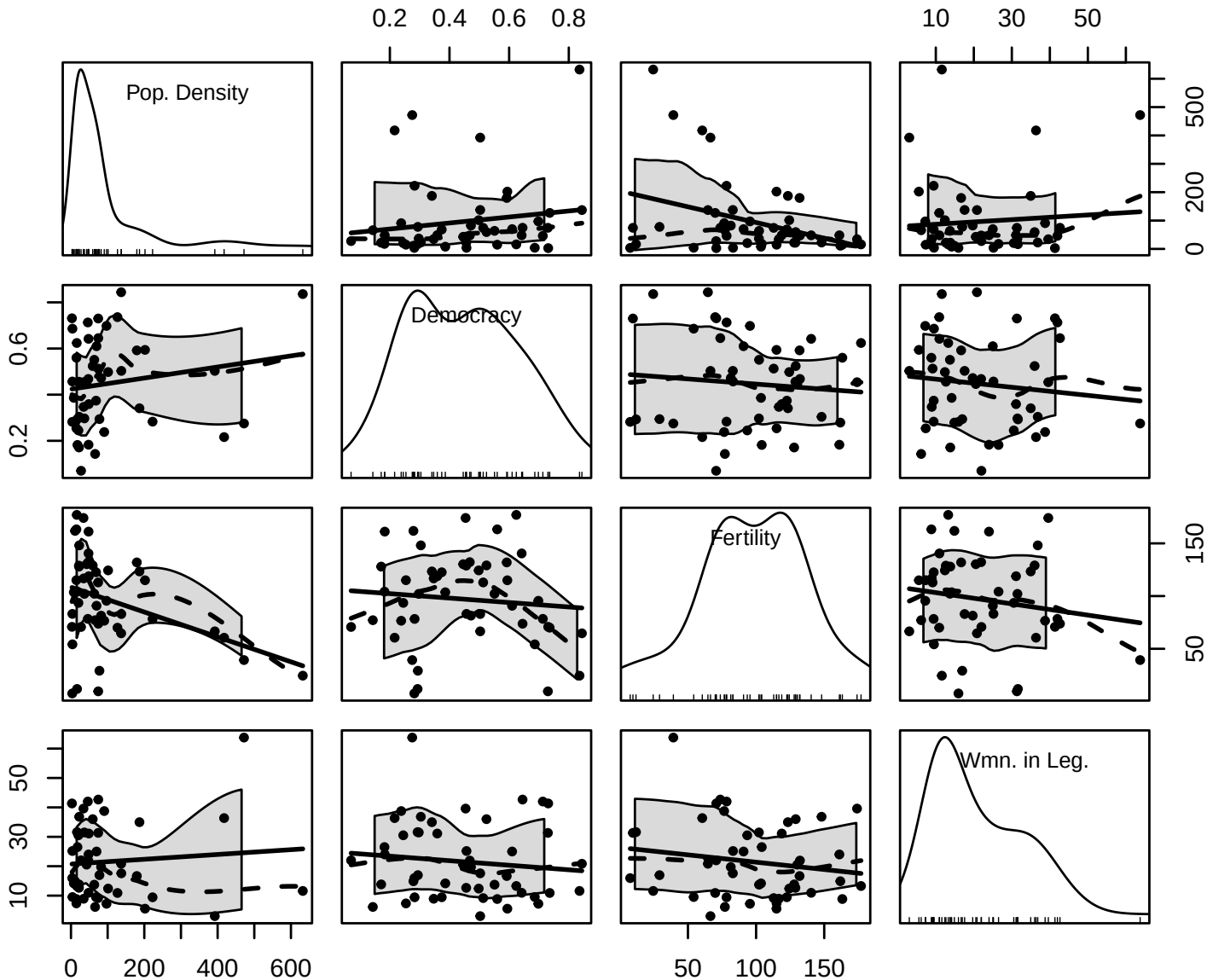
Multiple Conditioned Boxplots



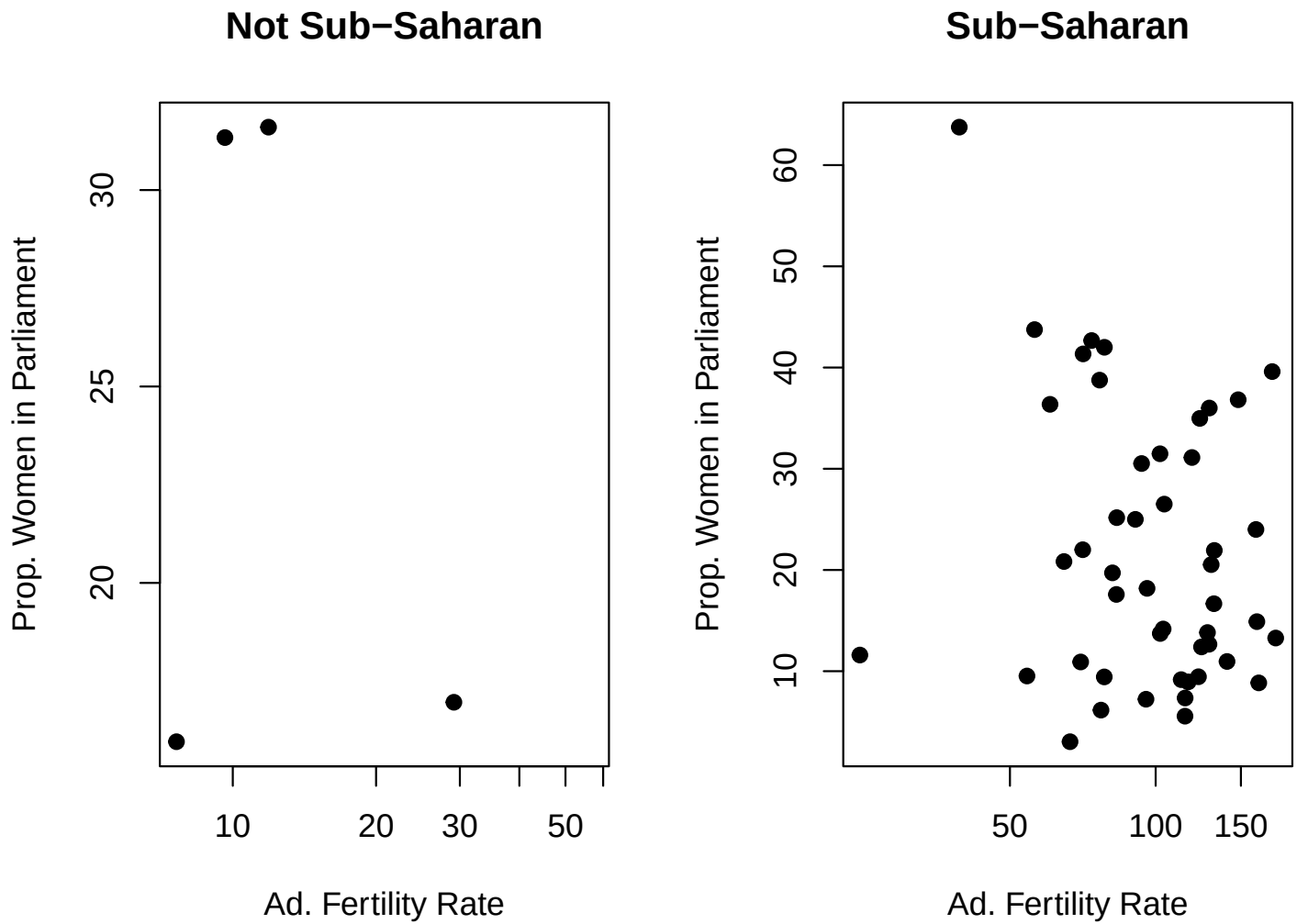
Empirical Q-Q Plot: Adolescent Fertility



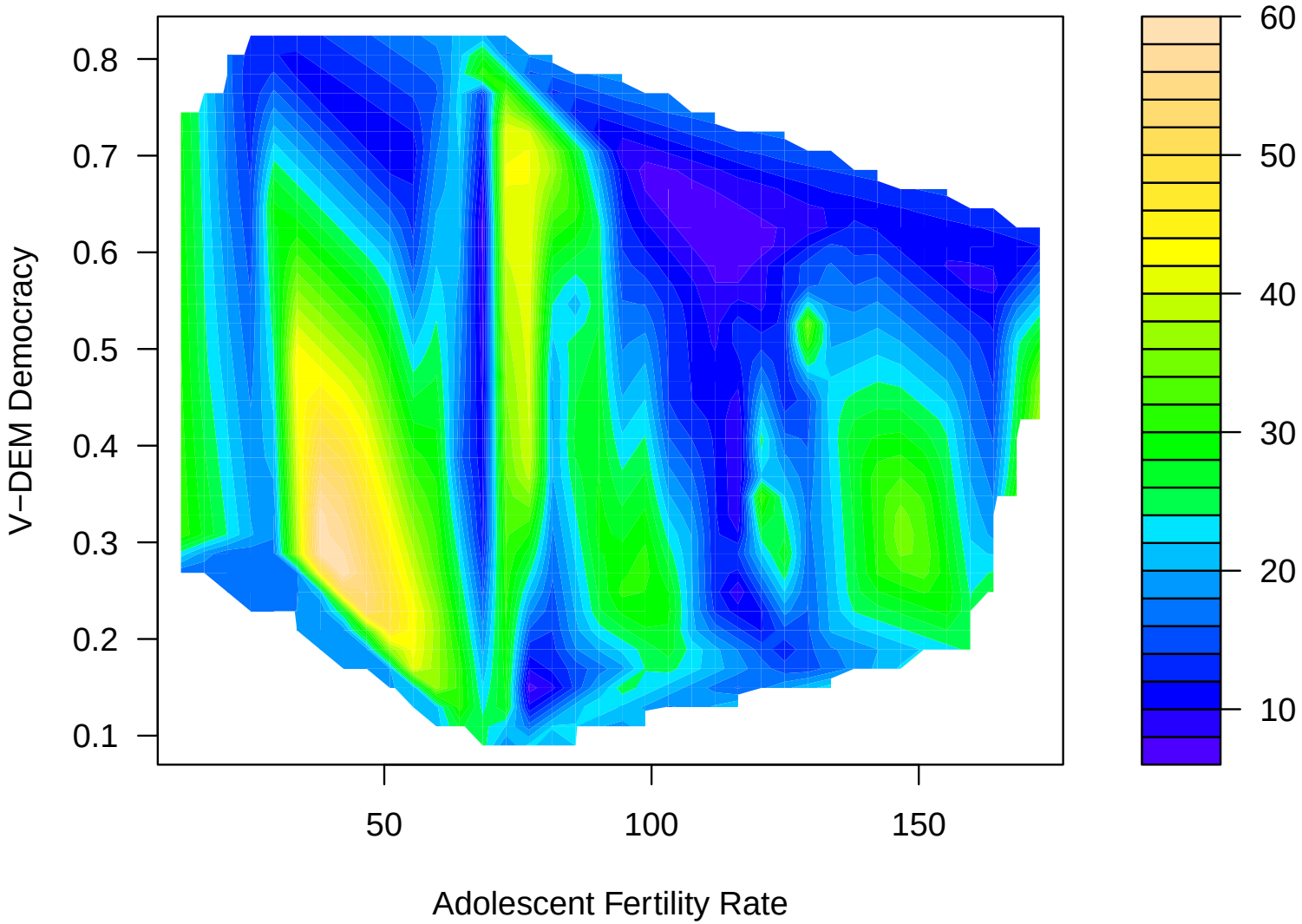
Scatterplot Matrix



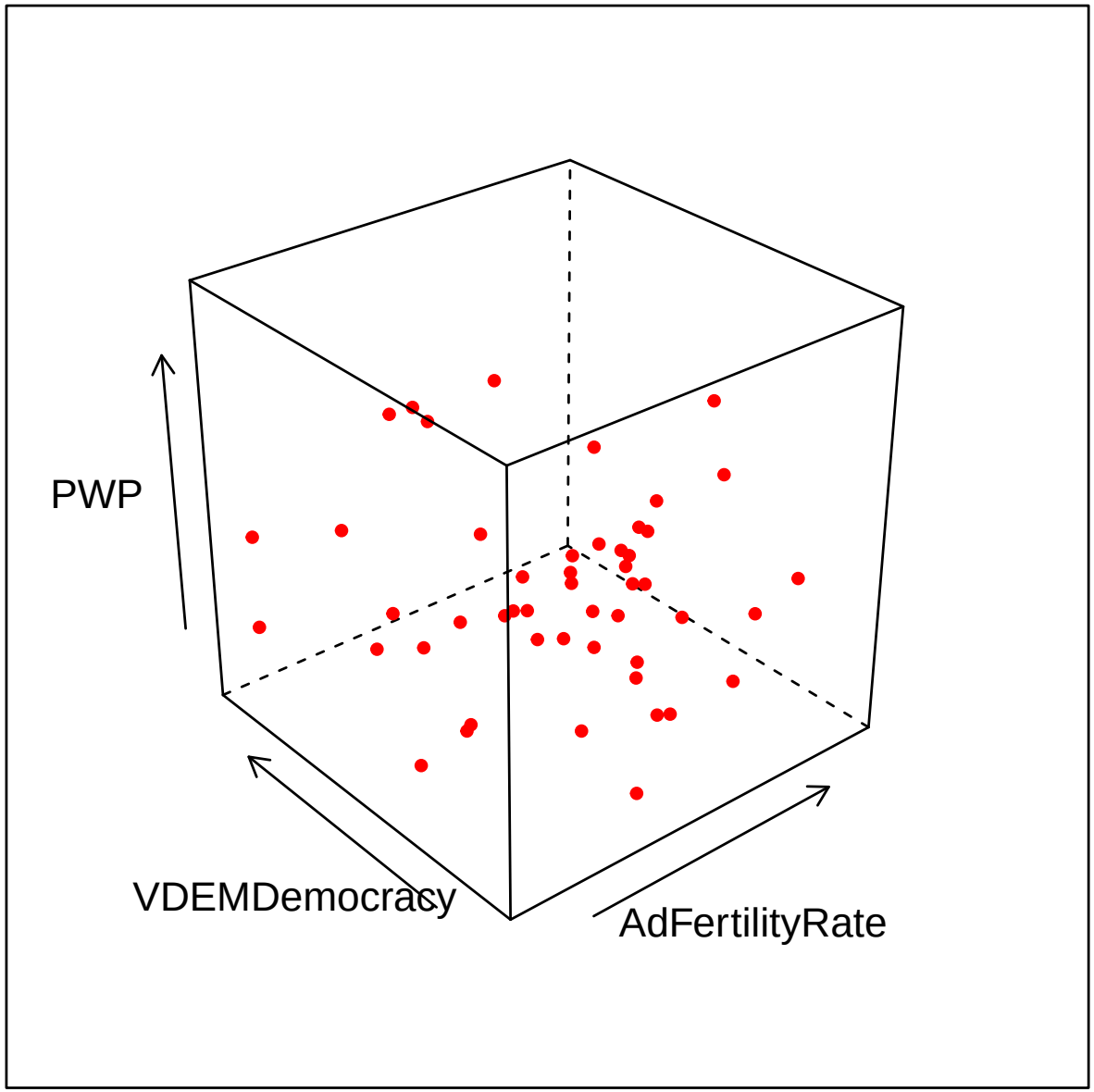
Conditional Scatterplots



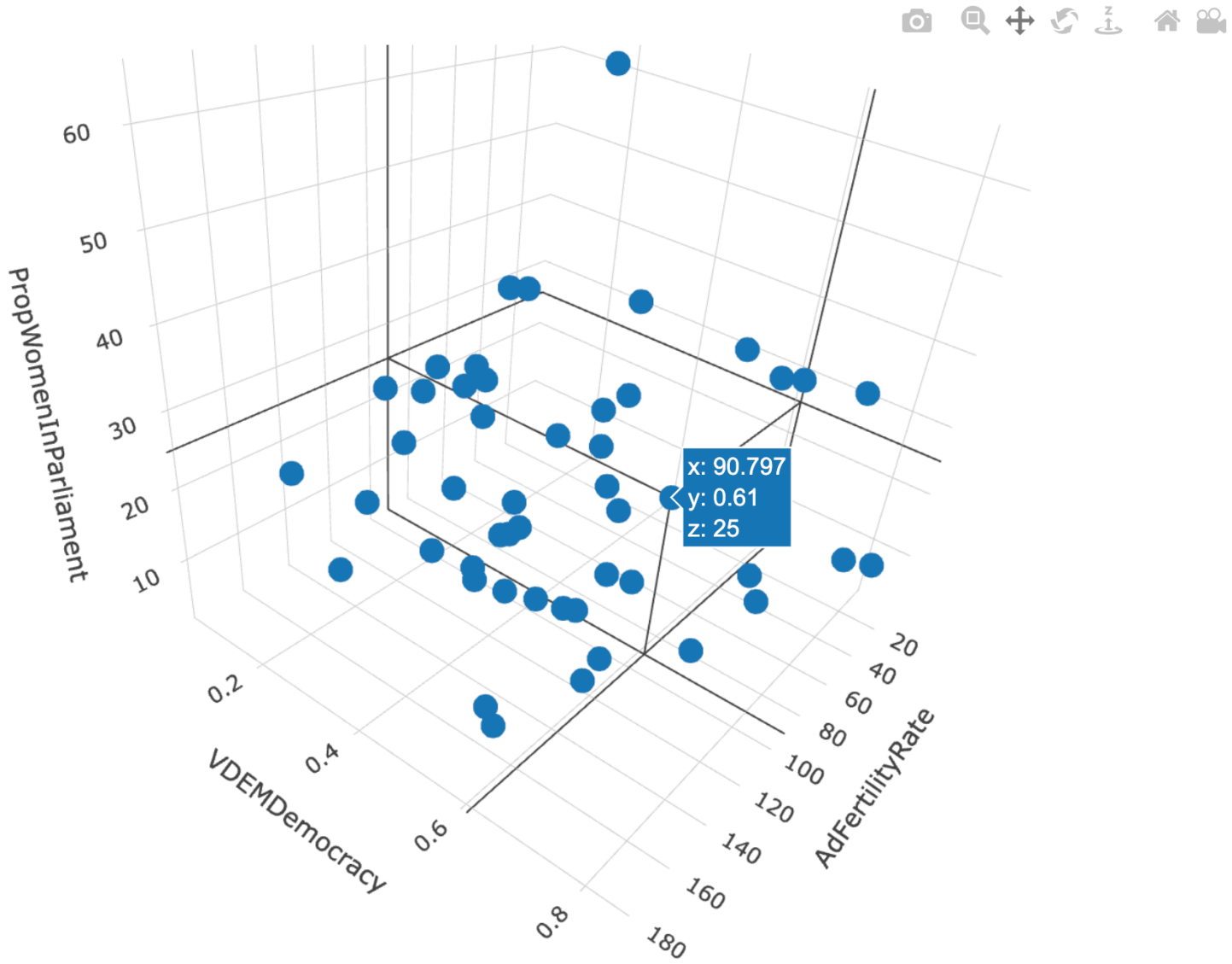
Contour Plot (Prop. Women Legislators)



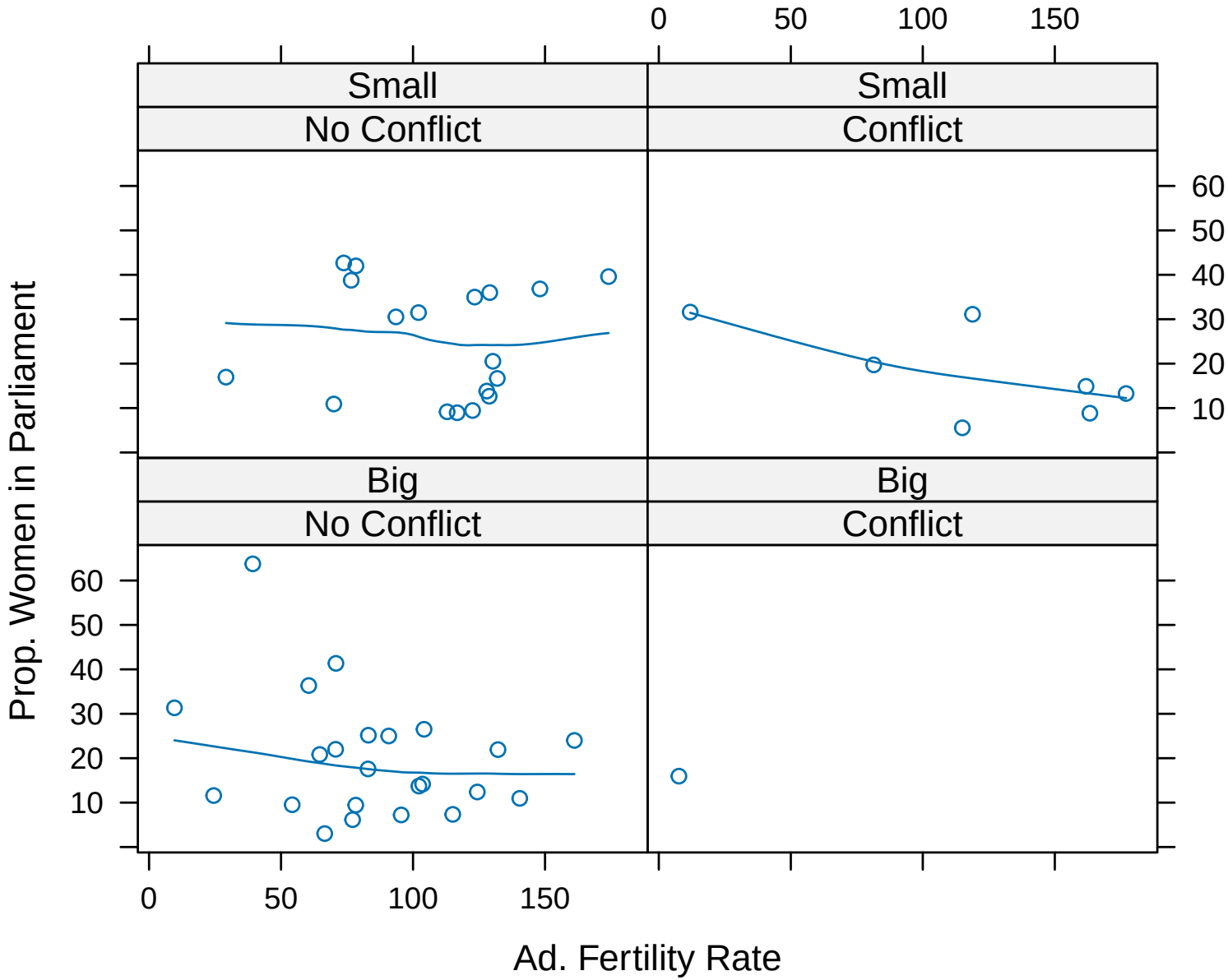
"3-D" Scatterplot



Interactive 3-D Scatterplot



"Four-Way" Scatterplots



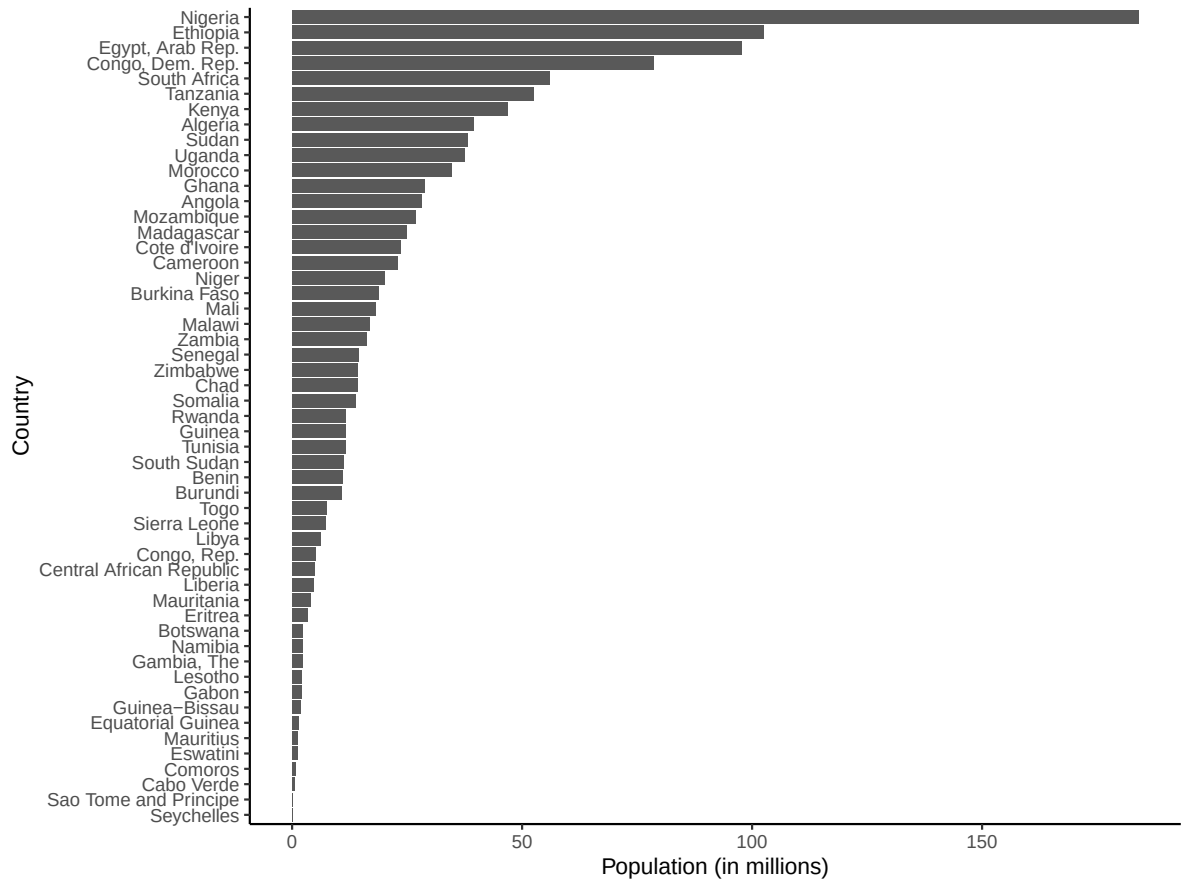
"Tidy" Graphics / Visualization

Visualization in the Tidyverse^{tm}:

- Loosely based on Wilkinson's "Grammar of Graphics"
- `ggplot2` is the core package for doing graphics in the Tidyverse^{tm}...
- ...but there are many others (check that page for any package starting with the letters gg...)
- Syntax is very different, and more "modular"
- Visualizations are built in layers / stages

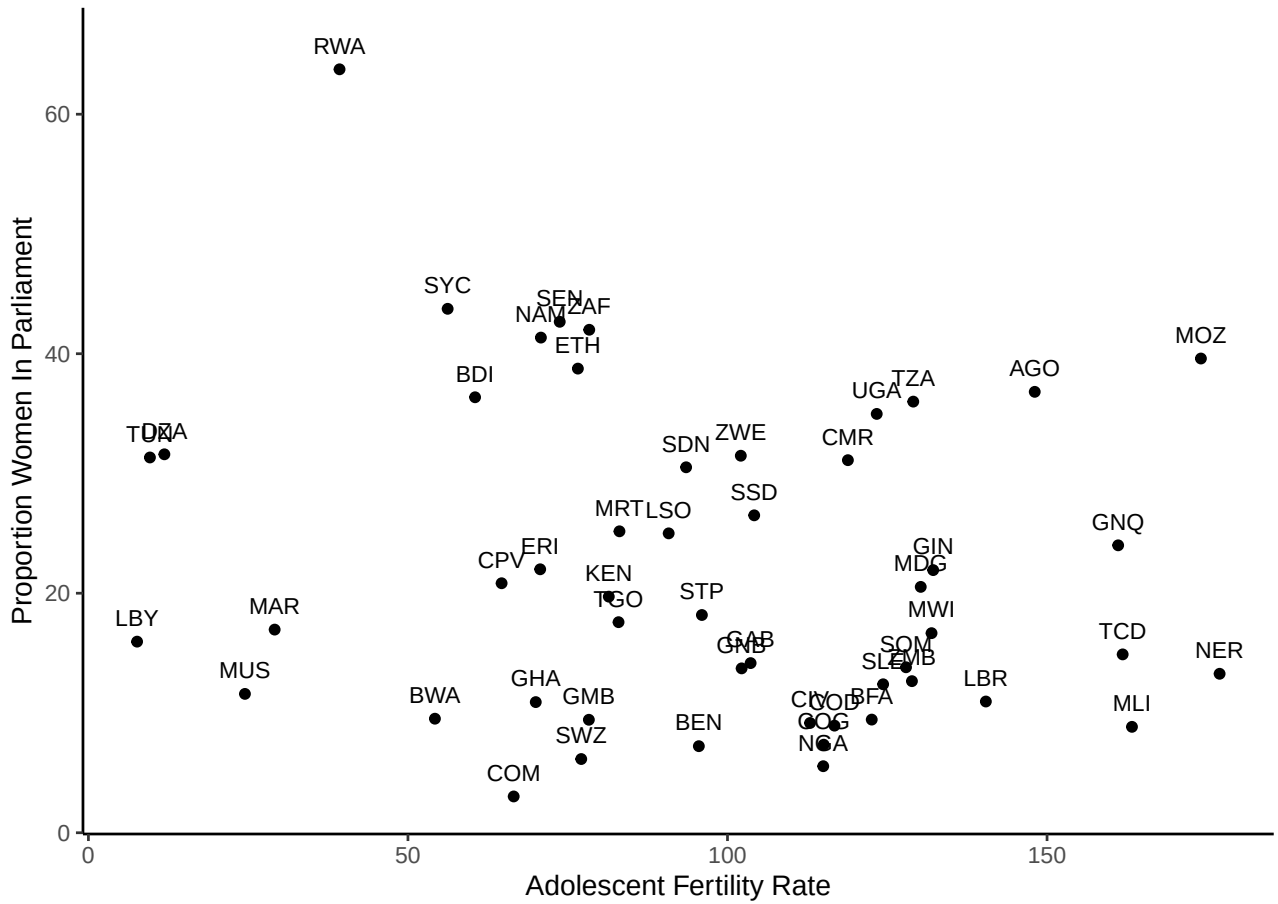
ggplot Example 1: Barchart

```
p<-ggplot(data=Africa, aes(x=reorder(Country,Population),
                           y=Population/1000000)) +
  geom_bar(stat="identity") +
  labs(y="Population (in millions)",x="Country") +
  theme_classic() + coord_flip()
p
```



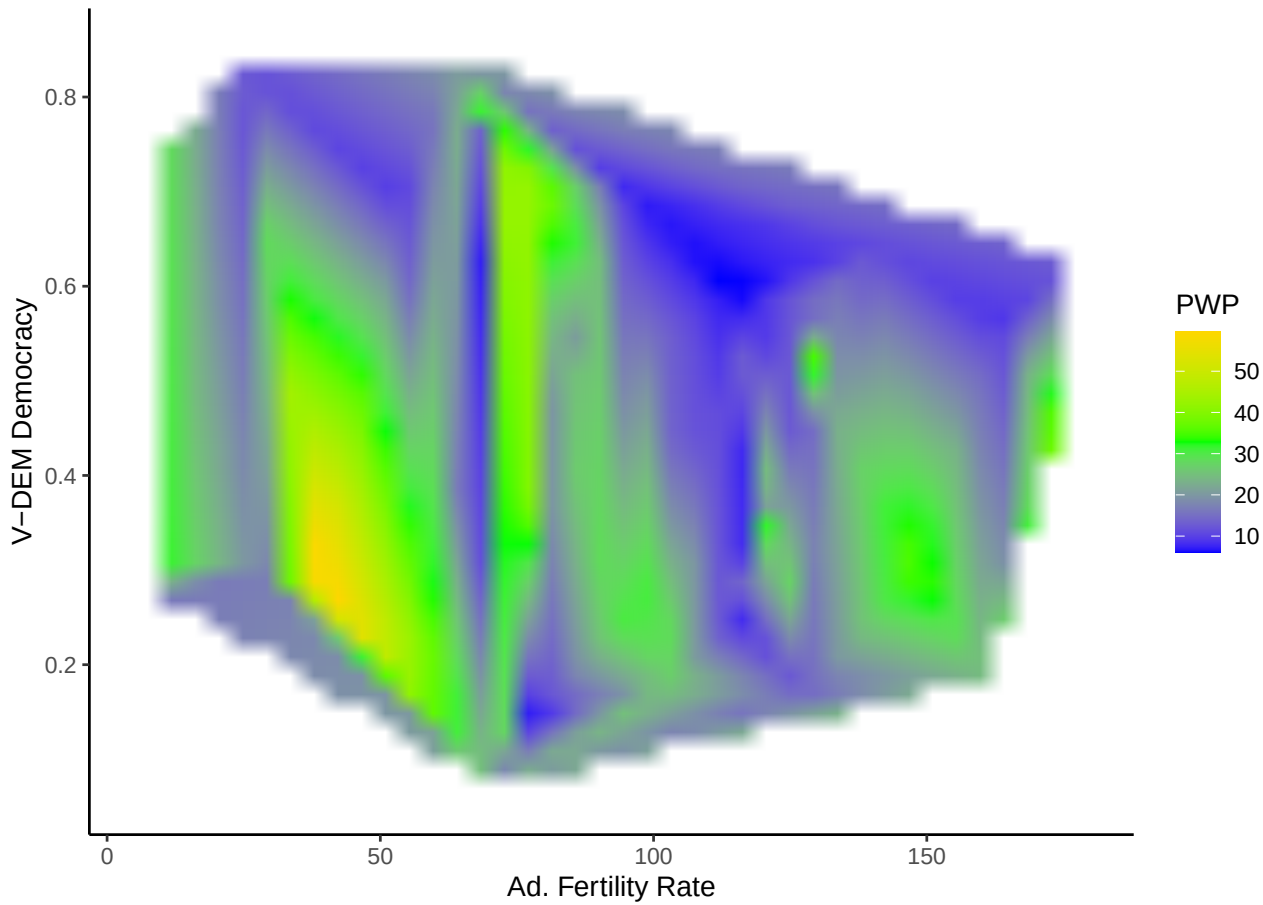
ggplot Example 2: Scatterplot

```
p2<-ggplot(data=Africa, aes(x=AdFertilityRate,y=PropWomenInParliament)) +
  geom_point() + theme_classic() +
  labs(y="Proportion Women In Parliament",x="Adolescent Fertility Rate") +
  geom_text(label=Africa$ISO3,size=3,nudge_y=2)
p2
```



ggplot Example 3: Contour Plot

```
p3<-ggplot(data=df,aes(x=x,y=y,fill=z)) +
  geom_raster(interpolate = TRUE) +
  scale_fill_gradientn(colours = c("blue","green","gold"),
                       na.value = "#FFFFFF",name="PWP") +
  labs(y="V-DEM Democracy",x="Ad. Fertility Rate") +
  theme_classic()
p3
```



R Graphics: The Power of `plot`

`plot`:

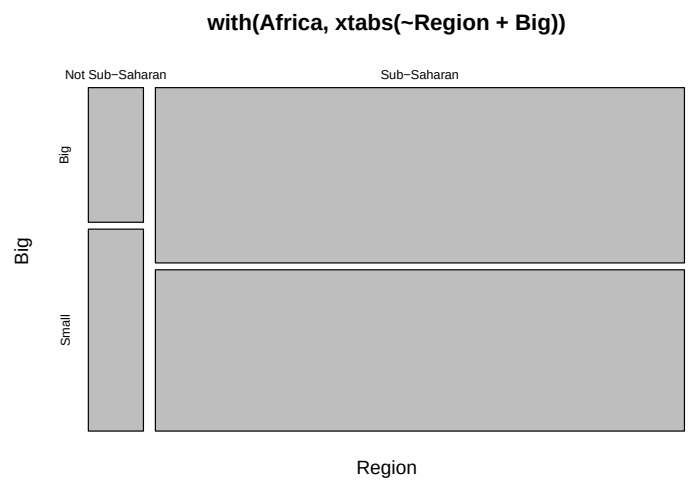
- `plot` (formally, `plot.default`) is the base-R graphics central command for visualization
- `plot()` is also a *method* – it does different things depending on what kind of object is placed inside the `()`s

Example:

```
> plot(with(Africa,xtabs(~Region+Big)))
```

Crosstable:

```
> with(Africa, xtabs(~Region+Big))
                 Big
Region            Big Small
  Not Sub-Saharan   2     3
  Sub-Saharan      25    23
```



R Graphics: Parameters

The `par` command sets graphical parameters; type `?par` on the R command line for more...

A few common / useful `par` commands:

- `par(mar(a,b,c,d))` sets the *margins* of the plot (`a` = bottom, `b` = left, `c` = top, `d` = right)
- `par(mfrow=c(x,y))` draws multiple figures on the same plot; `x` is the number of rows of figures, `y` is the number of columns
- `par(new)` allows for overplotting (drawing multiple graphs "on top of" each other)
- `xlog`, `ylog` allow for logarithmic scales on plots

R Graphics: Making Things

To create a graphic, you have to open a *graphics device*...

- The command sequence is basically (a) open the device, (b) do the things, (c) close the device (which outputs the file).
- Example:

```
> # Make a PDF in the local / working directory:
>
> pdf("MyPDF.pdf",7,5) # Turn on the PDF device; make the aspect ratio 7:5
>    (that is, seven units wide and five units tall)
> plot(muslperc,adrate,data=Africa) # Make the plot
> dev.off()  # Turn off the PDF-maker device
```

Available graphics devices include:

- `pdf()` (PDFs)
- `png()` (PNGs)
- `bmp()` (bitmaps)
- `jp()` (JPEGs)
- `tiff()` (TIFFs)