Continuous Variables, pt. 2

Weekly Savings

Search:

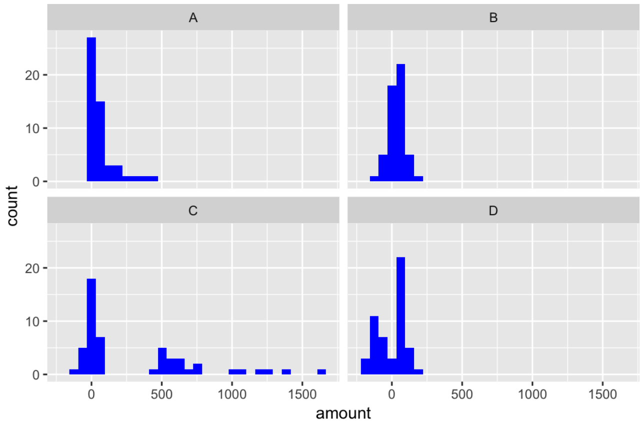
	A	B	C	D
1	$0.91	-$95.25	-$95.25	-$195.25
2	$1.50	-$75.12	-$75.12	-$175.12
3	$2.02	-$61.77	-$61.77	-$161.77
4	$2.40	-$46.18	-$46.18	-$146.18
5	$3.27	-$39.82	-$39.82	-$139.82
6	$4.77	-$37.62	-$37.62	-$137.62
7	$5.58	-$22.62	-$22.62	-$122.62
8	$6.65	-$16.22	-$16.22	-$116.22
9	$7.93	-$6.19	-$6.19	-$106.19
10	$10.86	-$4.29	-$4.29	-$104.29
11	$12.04	-$3.25	-$3.25	-$103.25
12	$13.92	-$2.04	-$2.04	-$102.04
13	$14.07	-$1.52	-$1.52	-$101.52
14	$14.23	$0.58	$0.58	-$99.42
15	$14.58	$8.38	$8.38	-$91.62
16	$16.23	$10.08	$10.08	-$89.92
17	$18.85	$13.60	$13.60	-$86.40
18	$19.98	$16.91	$16.91	-$83.09
19	$24.44	$17.47	$17.47	-$82.53
20	$25.11	$18.65	$18.65	-$81.35
21	$25.68	$20.10	$20.10	-$79.90

	A	B	C	D
22	$25.87	$24.33	$24.33	$24.33
23	$26.00	$28.20	$28.20	$28.20
24	$28.54	$31.10	$31.10	$31.10
25	$29.54	$31.81	$31.81	$31.81
26	$30.48	$32.74	$32.74	$32.74
27	$30.65	$35.03	$35.03	$35.03
28	$39.09	$37.77	$37.77	$37.77
29	$40.21	$40.51	$40.51	$40.51
30	$47.27	$40.71	$40.71	$40.71
31	$51.40	$41.00	$41.00	$41.00
32	$52.31	$45.79	$457.93	$45.79
33	$57.08	$48.48	$484.75	$48.48
34	$58.27	$49.30	$493.00	$49.30
35	$65.17	$49.78	$497.84	$49.78
36	$65.55	$52.18	$521.84	$52.18
37	$73.49	$52.62	$526.19	$52.62
38	$73.73	$54.15	$541.53	$54.15
39	$74.93	$55.68	$556.83	$55.68
40	$82.54	$59.80	$597.98	$59.80
41	$85.92	$62.60	$626.02	$62.60
42	$92.27	$65.14	$651.41	$65.14
43	$95.69	$65.37	$653.71	$65.37
44	$104.58	$70.36	$703.56	$70.36

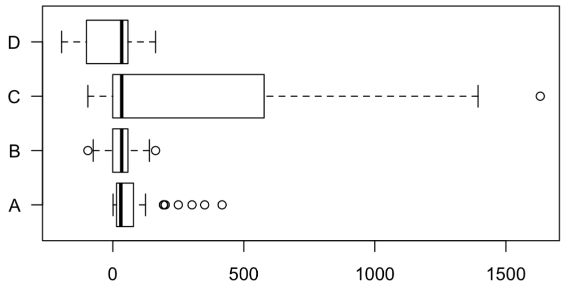
	A	B	C	D
45	$124.60	$76.70	$766.99	$76.70
46	$192.96	$78.21	$782.15	$78.21
47	$194.34	$103.50	$1,035.00	$103.50
48	$199.99	$109.22	$1,092.22	$109.22
49	$249.96	$119.50	$1,194.99	$119.50
50	$302.12	$128.15	$1,281.47	$128.15
51	$350.54	$139.37	$1,393.66	$139.37
52	$416.85	$163.11	$1,631.09	$163.11

Showing 1 to 52 of 52 entries

Histograms

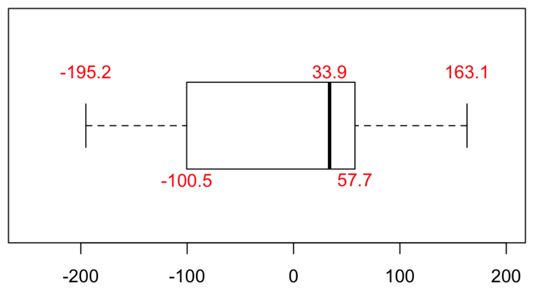


Boxplots



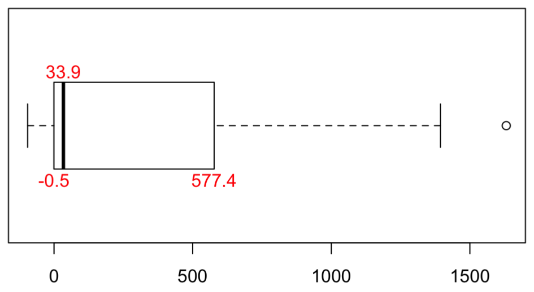
Boxplot (Person “D”)

```
##          min lower-hinge       median upper-hinge          max
##       -195.2      -100.5         33.9        57.7        163.1
```



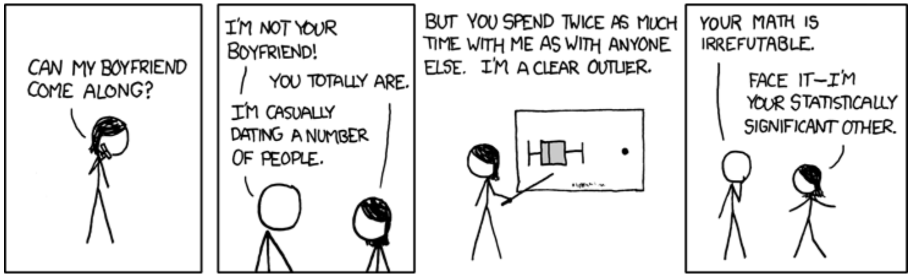
Boxplot with outliers (Person “C”)

```
##          min lower-hinge       median upper-hinge          max
##      -95.249      -0.473       33.889     577.408     1631.089
```



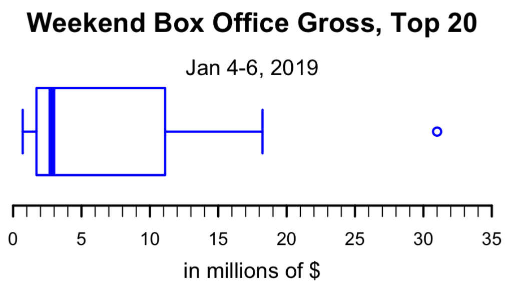
What does it take to be an outlier?

What does it take to be an outlier?


CAN MY BOYFRIEND COME ALONG?
I'M NOT YOUR BOYFRIEND!
YOU TOTALLY ARE.
I'M CASUALLY DATING A NUMBER OF PEOPLE.
BUT YOU SPEND TWICE AS MUCH TIME WITH ME AS WITH ANYONE ELSE. I'M A CLEAR OUTLIER.
YOUR MATH IS IRREFUTABLE.
FACE IT—I'M YOUR STATISTICALLY SIGNIFICANT OTHER.

https://www.explainxkcd.com/wiki/index.php/539:_Boyfriend

What does it take to be an outlier?

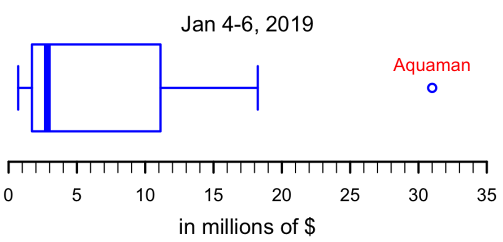


Weekend Box Office Gross, Top 20

Jan 4-6, 2019

Source: http://www.boxofficemojo.com/weekend/chart/

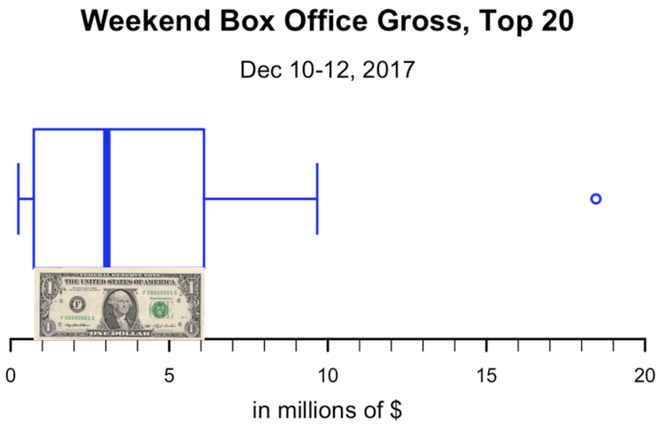
What does it take to be an outlier?



Weekend Box Office Gross, Top 20

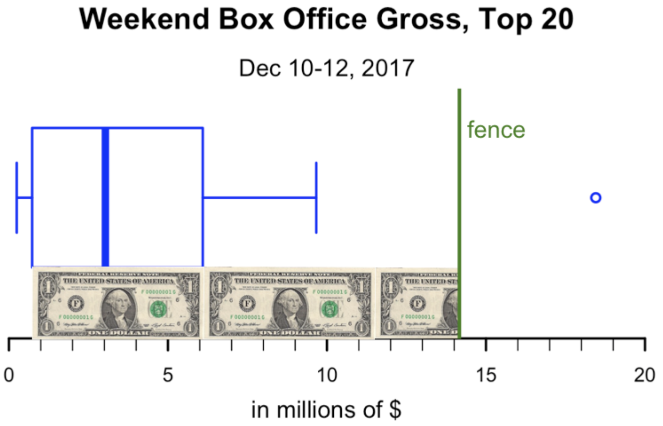
Jan 4-6, 2019

What does it take to be an outlier?



“H-spread” or fourth spread (upper hinge - lower hinge)

What does it take to be an outlier?

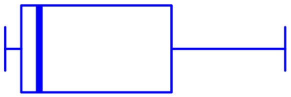


fences:

1.5 x hinge spread above upper-hinge

1.5 x hinge spread below lower-hinge

Fences

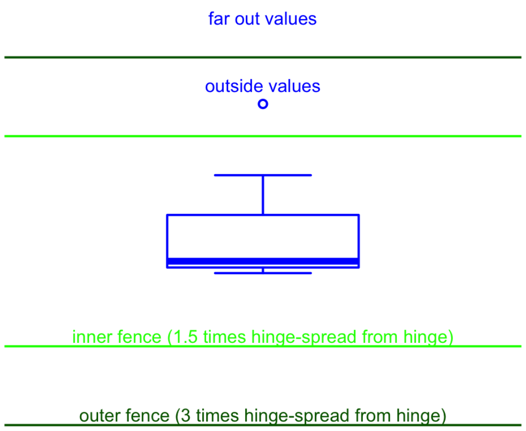


fences:

1.5 x hinge spread above upper-hinge

1.5 x hinge spread below lower-hinge

Tukey’s original boxplot


far out values
outside values
inner fence (1.5 times hinge-spread from hinge)
outer fence (3 times hinge-spread from hinge)

Quartiles

```
boxoffice
```

```
##  [1]  0.703  0.923  1.005  1.168  1.609  1.808  1.843  1.903  2.147  2.368
## [11]  3.303  4.674  4.755  5.735  9.110 13.127 13.203 15.861 18.238 31.003
```

```
fivenum(boxoffice) %>% set_names(fivenumnames)
```

```
##          min lower-hinge      median upper-hinge         max
##        0.703       1.709       2.835      11.118      31.003
```

```
quantile(boxoffice)
```

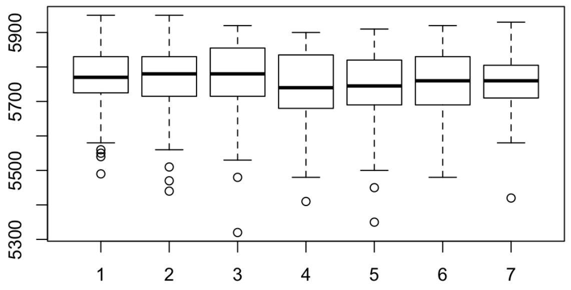
```
##     0%    25%    50%    75%   100%
##  0.703  1.758  2.835 10.114 31.003
```

See: ?quantile for different methods

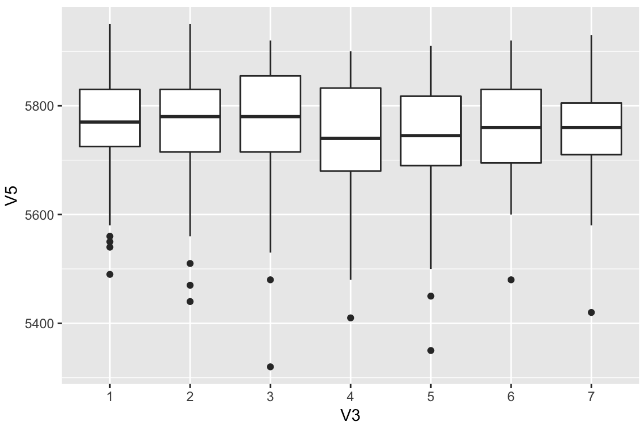
Sometimes boxplots are drawn using the IQR (interquartile range) instead of hinge spread

base R vs. ggplot2

```
library(mlbench)
data(Ozone)
boxplot(V5 ~ V3, data = Ozone)
```



```
ggplot(Ozone, aes(V3, V5)) + geom_boxplot()
```



Box plot stats

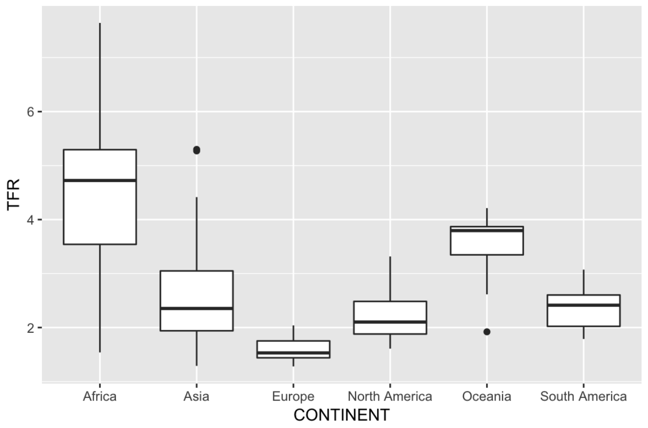
```r
# base R
boxplot.stats(df$`Weekend Gross`)
```

```
## $stats
## [1]  0.703  1.709  2.835 11.118 18.238
##
## $n
## [1] 20
##
## $conf
## [1] -0.489  6.160
##
## $out
## [1] 31
```

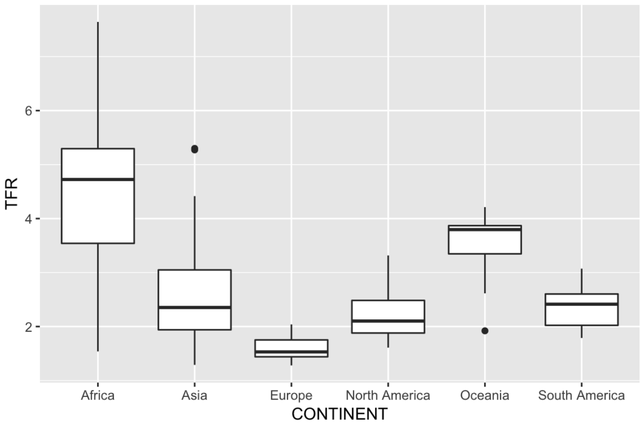
```r
# ggplot2
g <- ggplot(df, aes(1, `Weekend Gross`)) + geom_boxplot()
ggplot_build(g)$data[[1]]
```

ymin	lower	middle	upper	ymax	outliers	notchupper	notchlower	x	PANEL	group	ymin_final	ymax_final	xmin	xmax	xid	newx	new
0.703	1.76	2.83	10.1	18.2	31.00328	5.79	-0.117	1	1	-1	0.703	31	0.625	1.38	1	1	

Multiple box plots



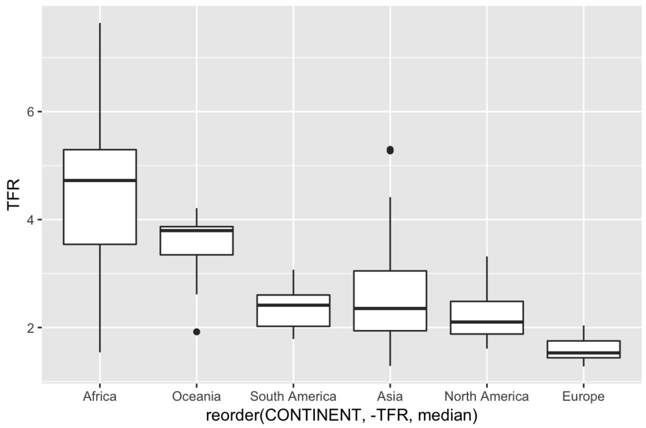
Multiple box plots



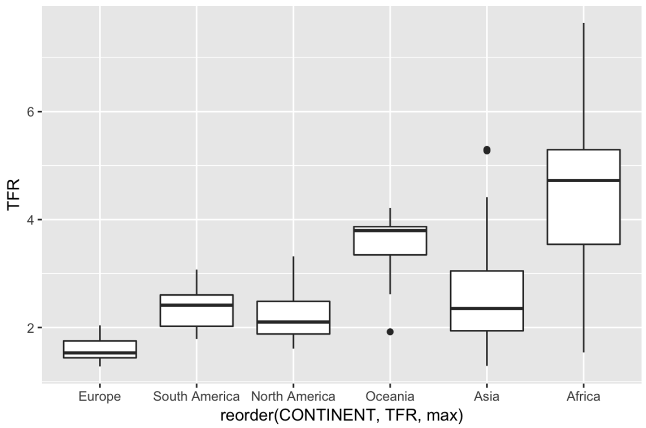
COUNTRY	CONTINENT	TFR
Afghanistan	Asia	5.27
Timor-Leste	Asia	5.30

COUNTRY	CONTINENT	TFR
Australia	Oceania	1.92

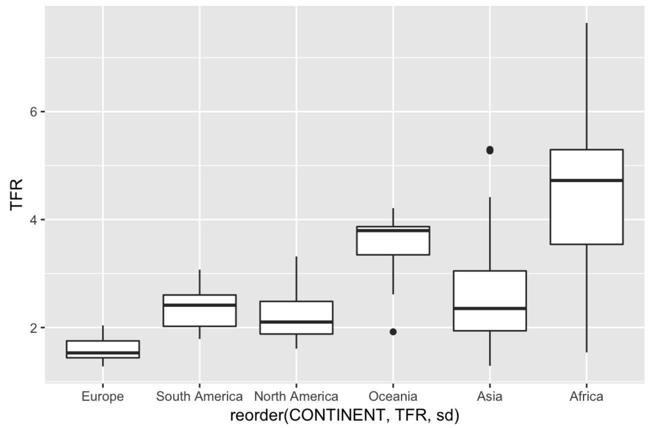
Reorder by median



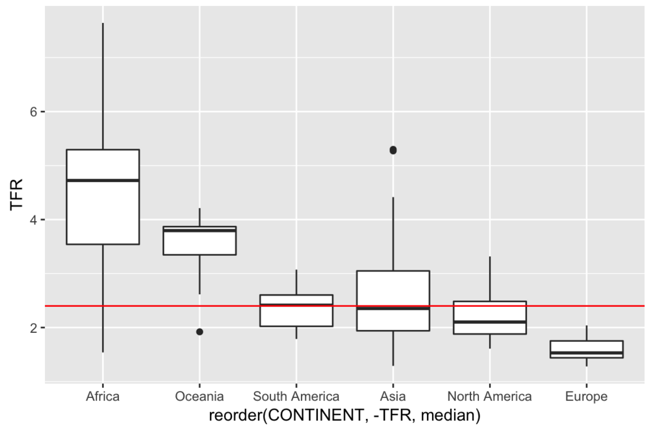
Reorder by maximum value



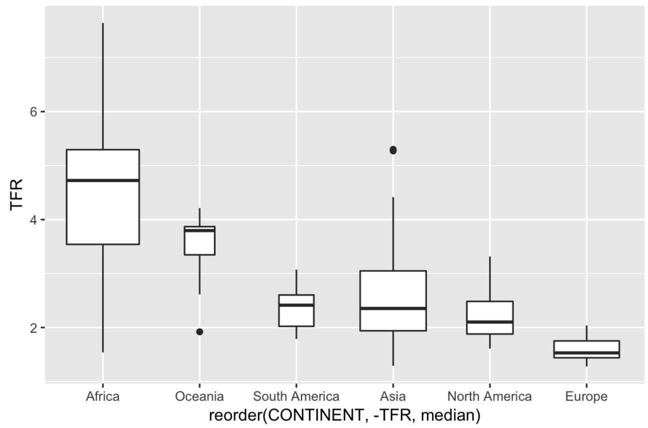
Reorder by standard deviation



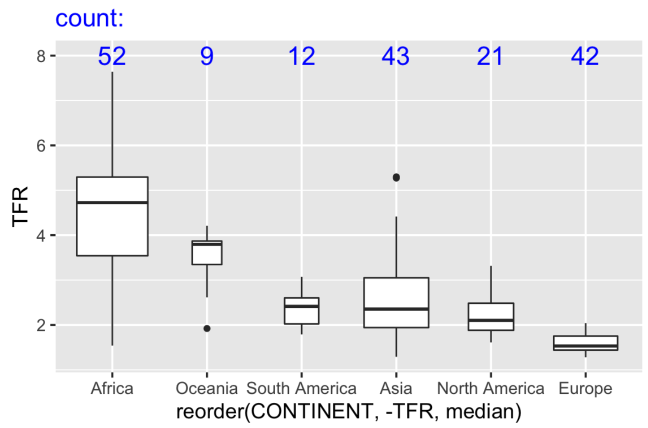
Add overall median line



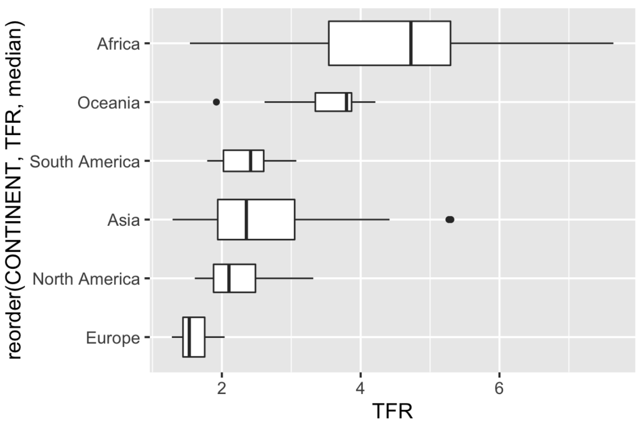
Variable width box plots



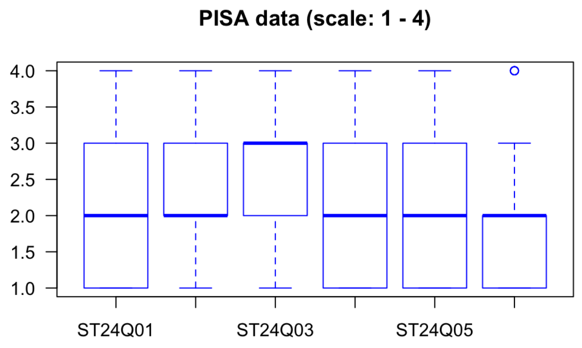
Add continent country count



Horizontal boxplot

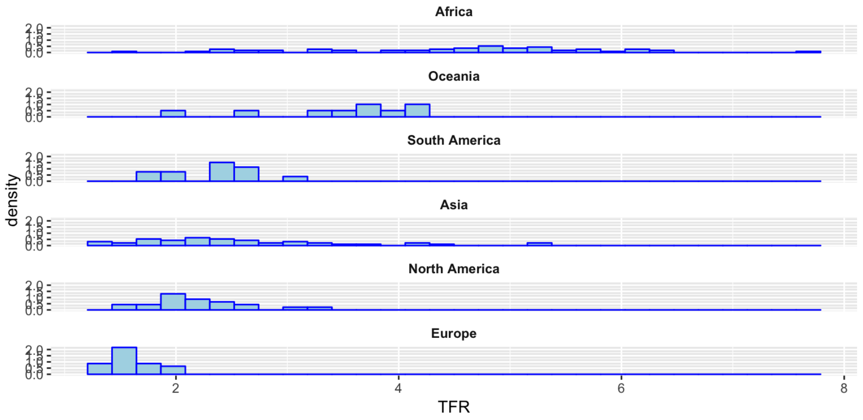


Not for discrete data

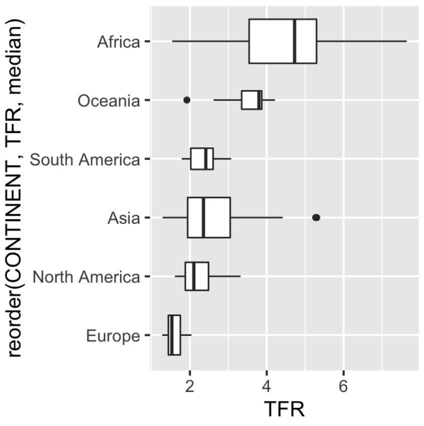


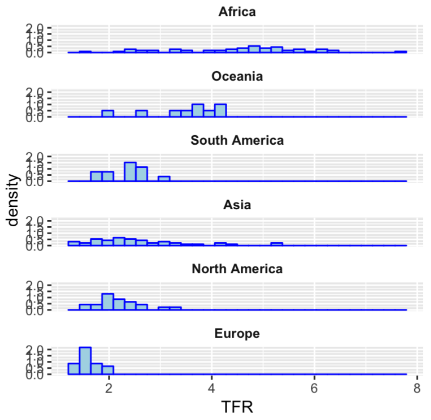
Source: R likert::pisaitems dataset

Multiple density histograms, ordered by median

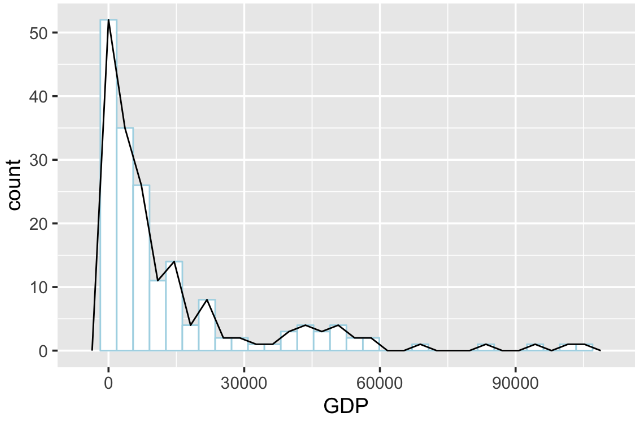


Boxplots vs. histograms

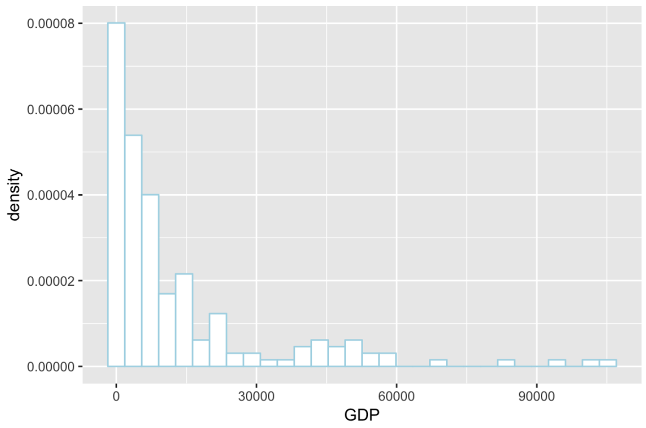




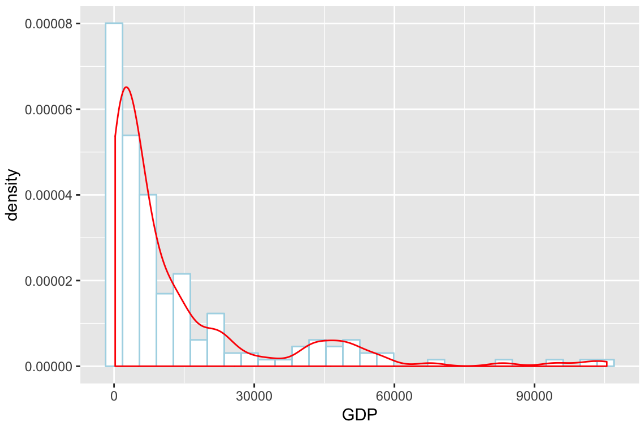
Frequency polygon



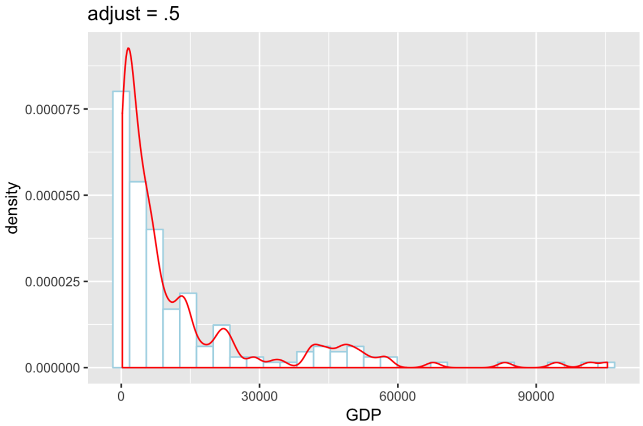
Density histogram



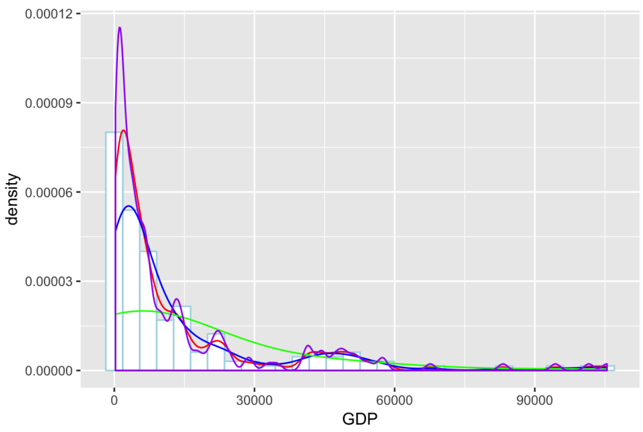
Density curve



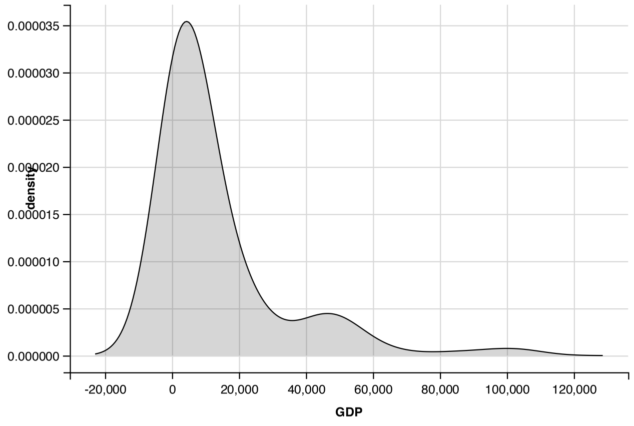
Density curve



Density curve: varying smoothing bandwidths

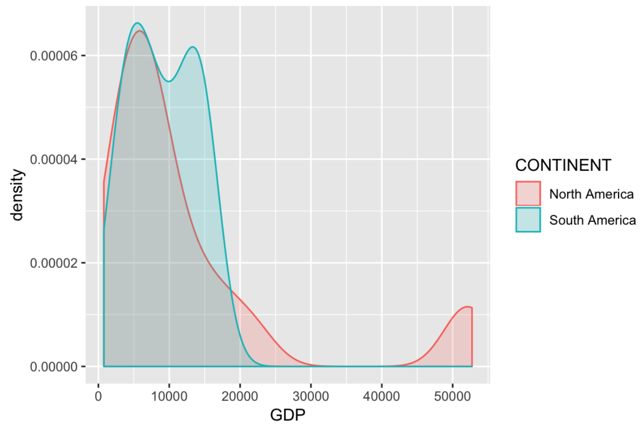


Density curve: varying smoothing bandwidths (`ggvis`)

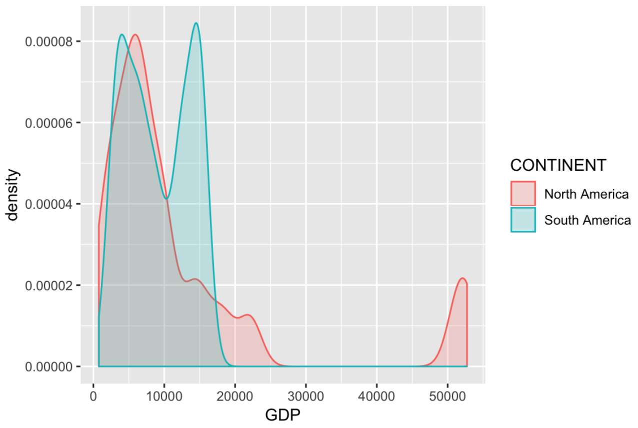


See also: http://ggvis.rstudio.com/0.1/quick-examples.html#histograms

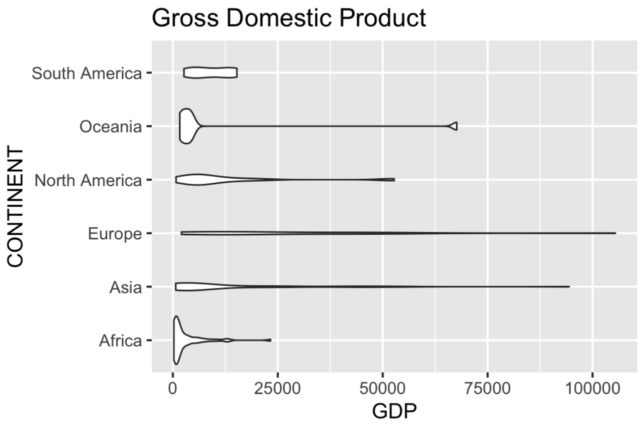
Density curves



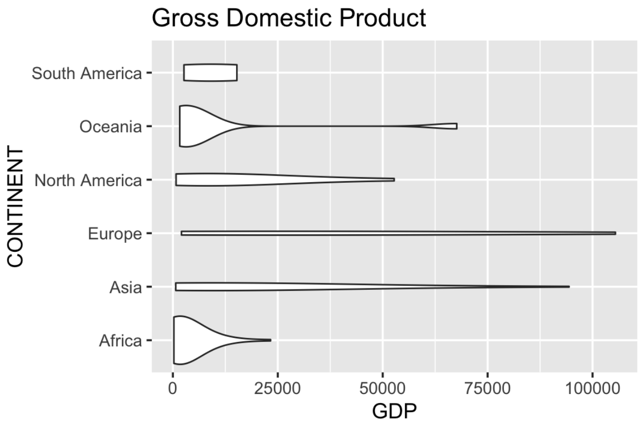
Density curves



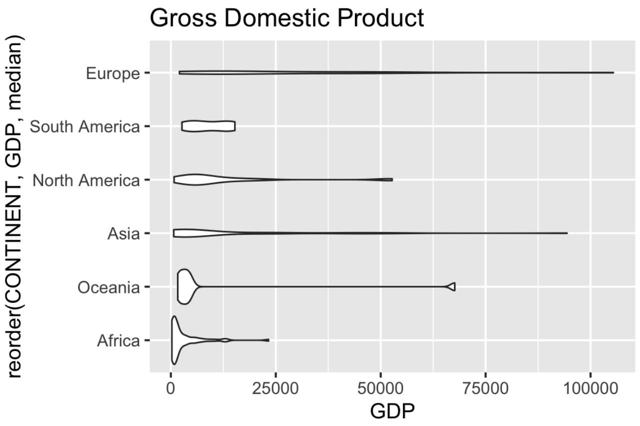
Violin plots



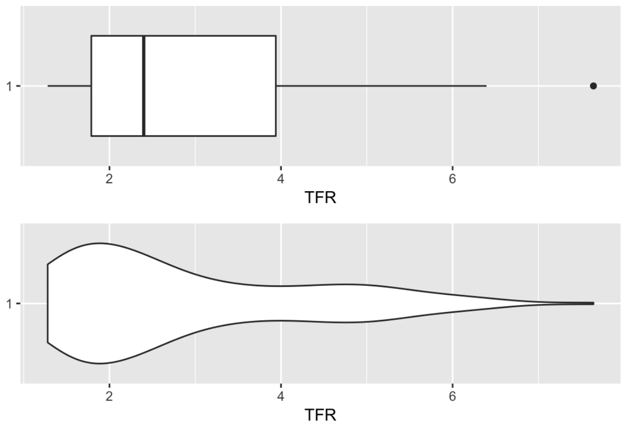
Violin plots, change bandwidth



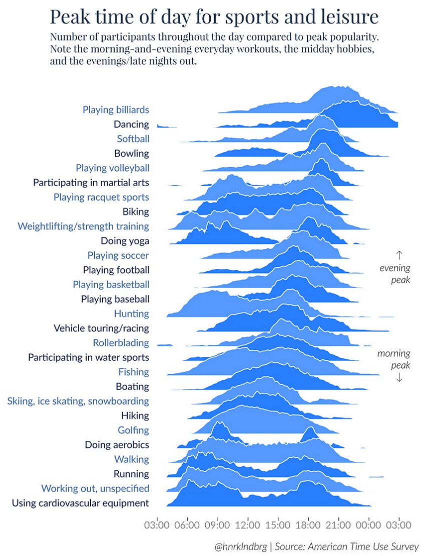
Violin plots, ordered by median



Box plot vs. violin plot



Ridgeline plot



Source: https://eagereyes.org/blog/2017/joy-plots

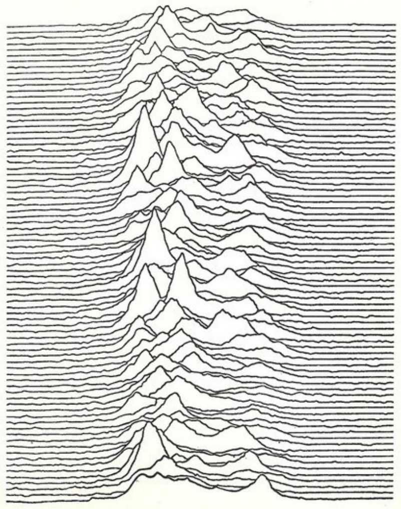
Additional resources:

http://blog.revolutionanalytics.com/2017/07/joyplots.html

https://blogs.scientificamerican.com/sa-visual/pop-culture-pulsar-origin-story-of-joy-division-s-unknown-pleasures-album-cover-video/

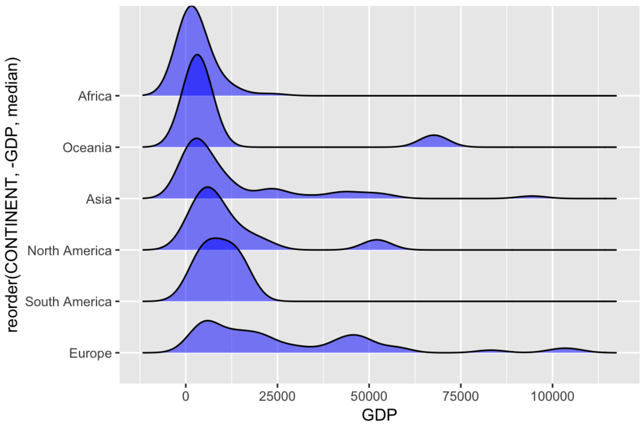
Ridgeline plot inspiration

Jocelyn Bell discovers first radio pulsars, 1967

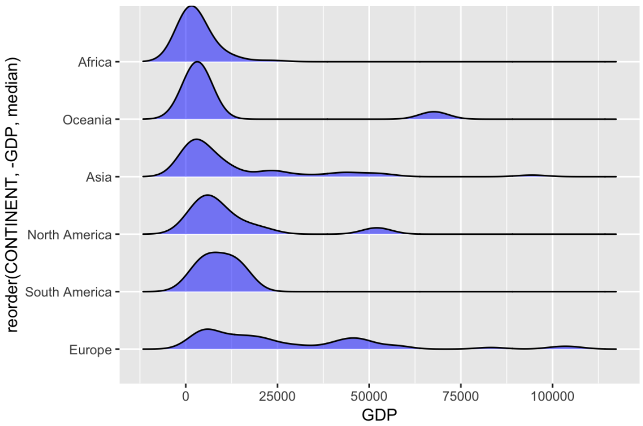


6.7: *Successive pulses from the first pulsar discovered, CP 1919, are here superimposed vertically. The pulses occur every 1.337 seconds. They are caused by a rapidly-spinning neutron star.*

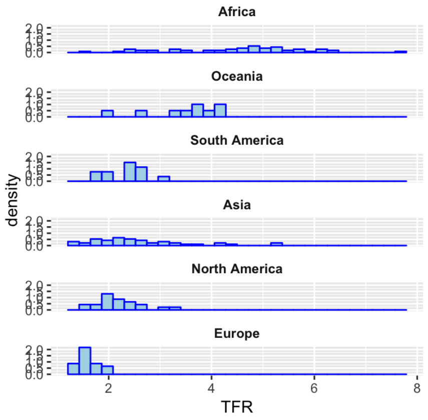
Ridgeline plot

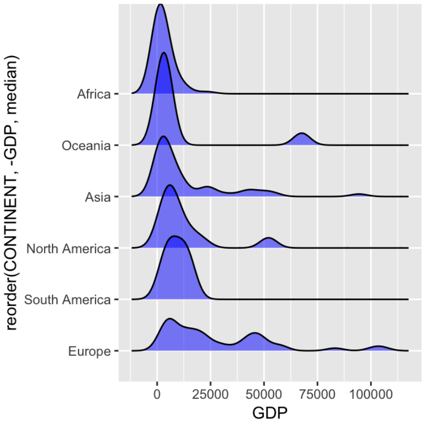


Ridgeline plot, change scale

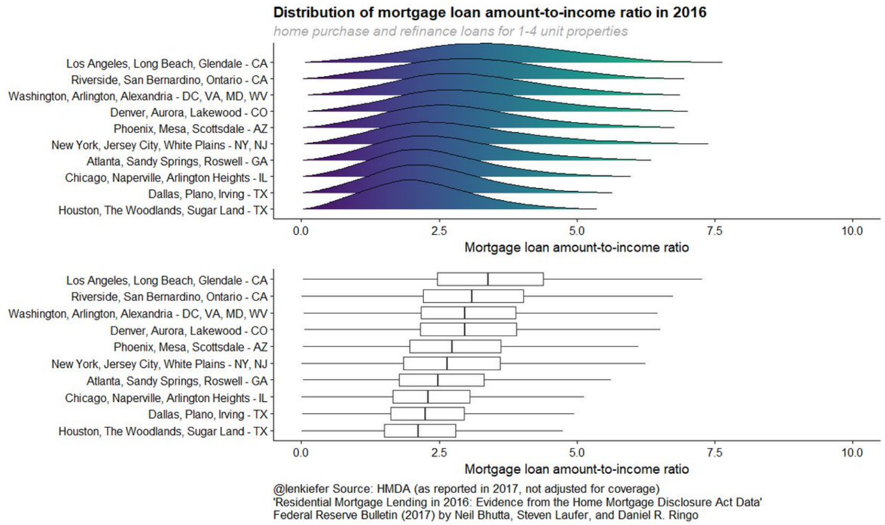


Histogram vs. ridgeline





Ridgeline vs. boxplot



@lenkiefer Source: HMDA (as reported in 2017, not adjusted for coverage)
'Residential Mortgage Lending in 2016: Evidence from the Home Mortgage Disclosure Act Data'
Federal Reserve Bulletin (2017) by Neil Bhutta, Steven Laufer, and Daniel R. Ringo

Source: https://twitter.com/lenkiefer/status/916823350726610946

`ggridge` package

CRAN https://CRAN.R-project.org/package=ggridges

Github https://github.com/clauswilke/ggridges

Package vignette(s) https://cran.r-project.org/web/packages/ggridges/vignettes/introduction.html

https://cran.r-project.org/web/packages/ggridges/vignettes/gallery.html

Package manual https://cran.r-project.org/web/packages/ggridges/ggridges.pdf