Python Section

we are going to be focused on histograms, box plots, and bullet charts and using various tools to create these visualizations.

In [94]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import math
from matplotlib.ticker import FuncFormatter
import plotly
import plotly.figure_factory as ff
from pandas.plotting import parallel_coordinates
import numpy as np

%matplotlib inline
```

Data read and parsing

In [2]:
```
education = pd.read_csv('ex6-2/education.csv')
crime = pd.read_csv('ex6-2/crimeratesbystate-formatted.csv')
birthrate = pd.read_csv('ex6-2/birth-rate.csv')

# remove whitespaces from crime dataset
education = education.applymap(lambda x: x.strip() if type(x) is str else x)
crime = crime.applymap(lambda x: x.strip() if type(x) is str else x)
birthrate = birthrate.applymap(lambda x: x.strip() if type(x) is str else x)
```

Histogram

Distribution of birth rate

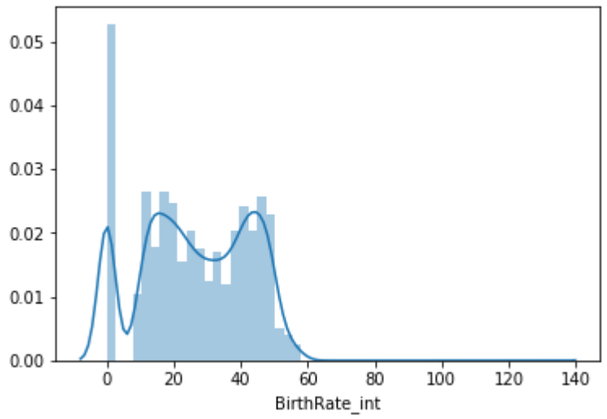
In [3]:
```
birthrate_hist = pd.melt(birthrate, id_vars="Country", var_name="Year", value_name = 'BirthRate').fillna(0)
birthrate_hist["BirthRate_int"] = birthrate_hist["BirthRate"].apply(lambda x: math.ceil(x))
birthrate_hist.head()
```

Out[3]:

	Country	Year	BirthRate	BirthRate_int
0	Aruba	1960	36.400	37
1	Afghanistan	1960	52.201	53
2	Angola	1960	54.432	55
3	Albania	1960	40.886	41
4	Netherlands Antilles	1960	32.321	33

In [4]:
```
sns.distplot( birthrate_hist["BirthRate_int"] )
```

Out[4]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2126adbffd0>
```

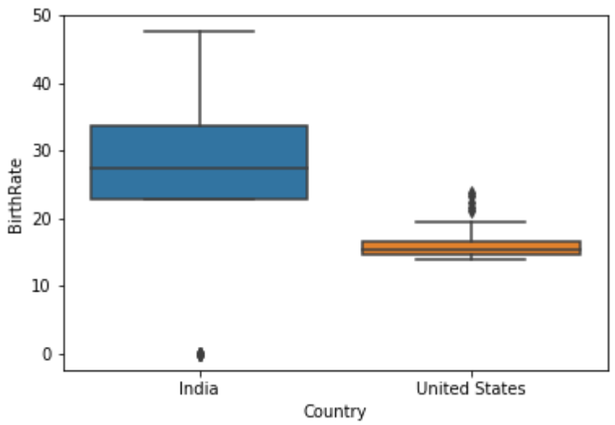


Box plot

Comparison of birthrate betwen India and USA

In [5]:
```
birthrate_box = birthrate_hist[(birthrate_hist["Country"]=="United States") | (birthrate_hist["Country"]=="India")]
sns.boxplot(x = birthrate_box["Country"], y=birthrate_box["BirthRate"])
```

Out[5]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2126c1995c0>
```



Bullet chart

US burglary statistics against a dummy benchmark

In [52]:
```
# transform data
crime_bullet = crime[crime["state"]=="United States"][["state","burglary"]]
crime_bullet['target'] = 500
crime_bullet_tuple = [tuple(x) for x in crime_bullet.values][0]

# set parameter for bullet chart
limits = [300, 500, 1000]
palette = sns.color_palette("Blues_r", len(limits))
fig, ax = plt.subplots()
ax.set_aspect('equal')
ax.set_yticks([1])
ax.set_yticklabels(crime_bullet_tuple[0])

prev_limit = 0
for idx, lim in enumerate(limits):
```

```
    ax.barh([1], lim-prev_limit, left=prev_limit, height=75, color=palette[idx])
    prev_limit = lim

# draw the value we're measuring
ax.barh([1], crime_bullet_tuple[1], color='black', height=45)

ax.axvline(crime_bullet_tuple[2], color="gray", ymin=0.10, ymax=0.9)
```

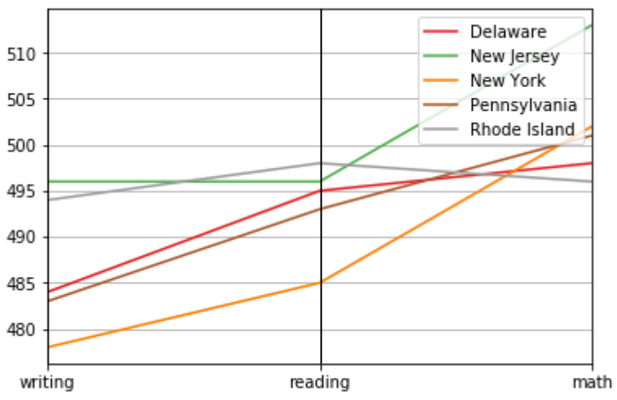
Out[52]: <matplotlib.lines.Line2D at 0x2126d488358>

Parallel Coordinate plot

Comparison of reading, writing and math numbers between 5 states

In [79]:

```
# transform data
education_parallel = education[education['state'].isin(['New York','New Jersey','Delaware','Rhode Island','Pennsylvania'])][['state','writing','reading','math']]

# make the plot
parallel_coordinates(education_parallel, 'state', colormap=plt.get_cmap("Set1"))
plt.show()
```

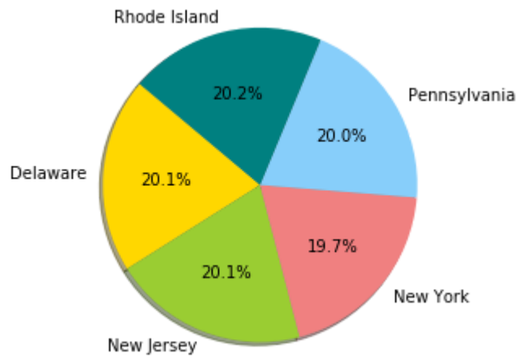


Pie chart

Comparison of reading numbers between 5 states

In [93]:

```
# transform data
education_pie = education_parallel[['state','reading']]

# set colors
colors = ['gold', 'yellowgreen', 'lightcoral', 'lightskyblue','teal']

# plot
plt.pie(education_pie['reading'], labels=education_pie['state'], colors=colors,
autopct='%1.1f%%', shadow=True, startangle=140)

plt.axis('equal')
plt.show()
```

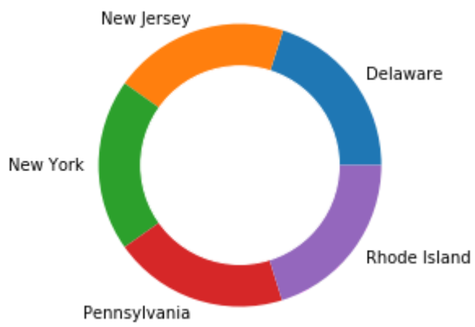


Donought chart

Comparison of reading, writing and math numbers between 5 states

In [120…

```
# transform data
education_donut = education_pie

# create a pieplot
plt.pie(education_donut['reading'], labels=education_donut['state'])

# add a circle at the center
my_circle=plt.Circle( (0,0), 0.7, color='white')
p=plt.gcf()
p.gca().add_artist(my_circle)

plt.show()
```



R Section

we are going to be focused on histograms, box plots, and bullet charts and using various tools to create these visualizations

Data read and preparation

In [8]:

```
library('magrittr')
source("BulletGraph.R", local=TRUE)

# load birth rate data
birthrate <- read.csv('ex6-2/birth-rate.csv')

# load crime data
crime <- read.csv('ex6-2/crimeratesbystate-formatted.csv')

# load education data
education <- read.csv('ex6-2/education.csv')

# check column names
colnames(birthrate)
```

1. 'Country'
2. 'X1960'
3. 'X1961'
4. 'X1962'
5. 'X1963'
6. 'X1964'
7. 'X1965'
8. 'X1966'
9. 'X1967'
10. 'X1968'
11. 'X1969'
12. 'X1970'
13. 'X1971'
14. 'X1972'
15. 'X1973'
16. 'X1974'
17. 'X1975'
18. 'X1976'
19. 'X1977'
20. 'X1978'
21. 'X1979'
22. 'X1980'
23. 'X1981'
24. 'X1982'
25. 'X1983'
26. 'X1984'
27. 'X1985'
28. 'X1986'
29. 'X1987'
30. 'X1988'

31. 'X1989'
32. 'X1990'
33. 'X1991'
34. 'X1992'
35. 'X1993'
36. 'X1994'
37. 'X1995'
38. 'X1996'
39. 'X1997'
40. 'X1998'
41. 'X1999'
42. 'X2000'
43. 'X2001'
44. 'X2002'
45. 'X2003'
46. 'X2004'
47. 'X2005'
48. 'X2006'
49. 'X2007'
50. 'X2008'

In [2]:

```
# format year columns
colnames(birthrate) <- gsub("X", "", colnames(birthrate))

# check column names
colnames(birthrate)
```

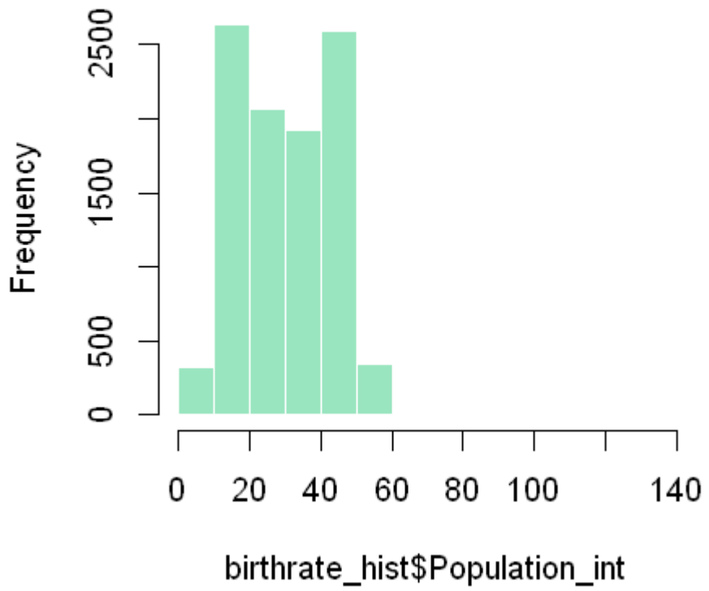
1. 'Country'
2. '1960'
3. '1961'
4. '1962'
5. '1963'
6. '1964'
7. '1965'
8. '1966'
9. '1967'
10. '1968'
11. '1969'
12. '1970'
13. '1971'
14. '1972'
15. '1973'
16. '1974'
17. '1975'
18. '1976'
19. '1977'
20. '1978'
21. '1979'

22. '1980'
23. '1981'
24. '1982'
25. '1983'
26. '1984'
27. '1985'
28. '1986'
29. '1987'
30. '1988'
31. '1989'
32. '1990'
33. '1991'
34. '1992'
35. '1993'
36. '1994'
37. '1995'
38. '1996'
39. '1997'
40. '1998'
41. '1999'
42. '2000'
43. '2001'
44. '2002'
45. '2003'
46. '2004'
47. '2005'
48. '2006'
49. '2007'
50. '2008'

Histogram

In [5]:

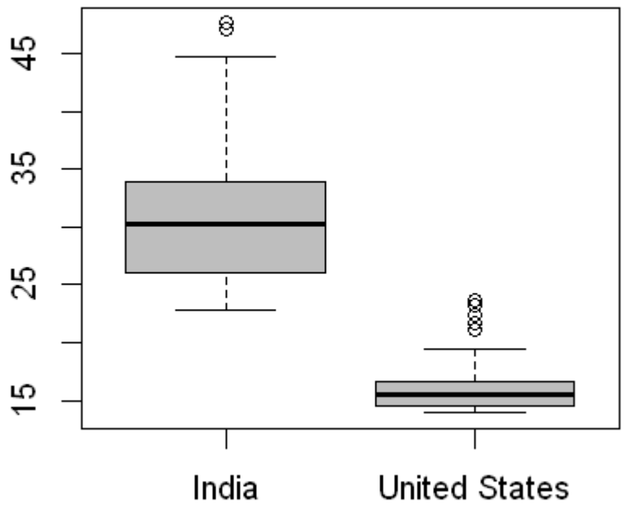
```
options(repr.plot.width = 4, repr.plot.height = 4)

# create pivotted data for plotting
birthrate_hist <- reshape2::melt(birthrate, id=c("Country")) %>%
  dplyr::mutate("Country" = as.character(Country),
                "Year" = as.character(variable),
                "Population" = value,
                "Population_int" = ceiling(value)) %>%
  dplyr::select(c("Country","Year","Population", "Population_int"))

# create histogram of population data
hist(birthrate_hist$Population_int, col=rgb(0.2,0.8,0.5,0.5) , border=F , main="")
```



Box plot

In [6]:

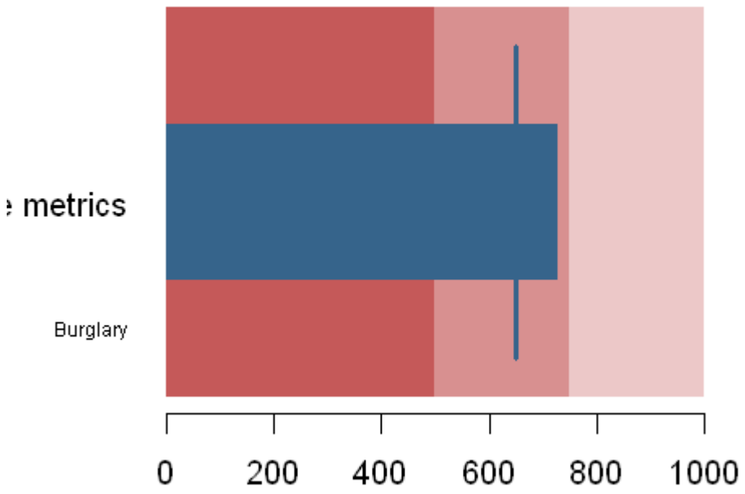
```
# create box plot of population data
birthrate_box <- birthrate_hist %>%
  dplyr::filter(Country %in% c("United States", "India"))

boxplot(birthrate_box$Population ~ birthrate_box$Country , col="grey")
```



Bullet chart

In [9]:

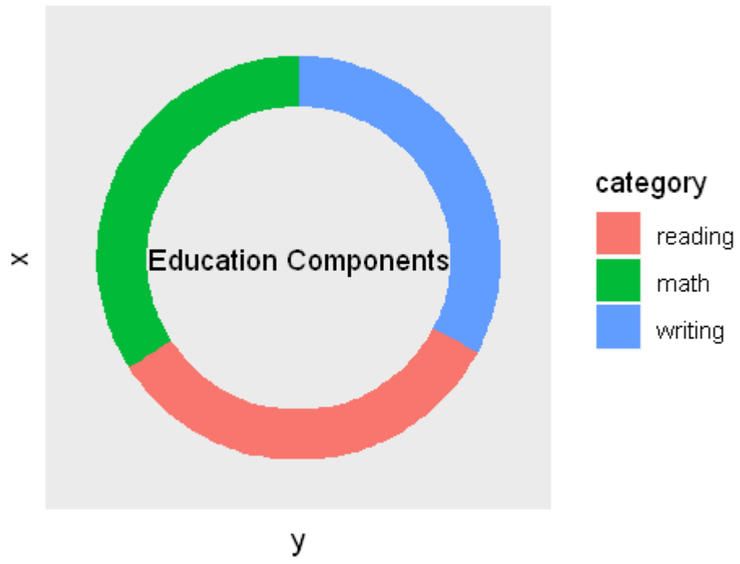
```
# create bullet chart with crime data
crime_bullet <- crime %>%
  dplyr::filter(stringr::str_trim(state, "both") == "United States") %>%
  dplyr::select(c(state, burglary))

bulletgraph(x=crime_bullet$burglary,ref=650,limits=c(0,500,750,1000),
            name= "USA Crime metrics",subname="Burglary",
            col="steelblue4",shades="firebrick")
```



Donut chart

In [10]:

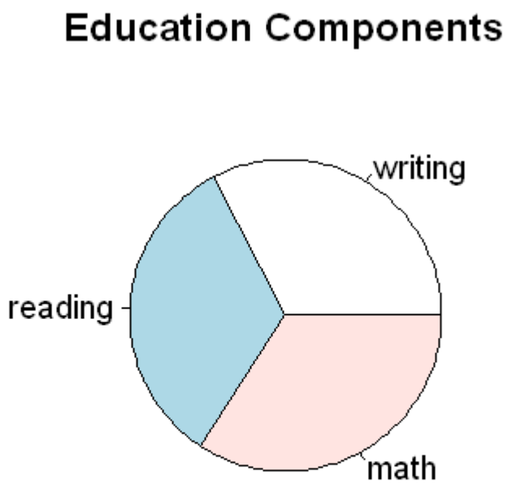
```
# donut chart using USA crime data
education_donut <- education %>%
  dplyr::filter(stringr::str_trim(state, "both") == "United States") %>%
  reshape2::melt(id=c("state")) %>%
  dplyr::rename("category" = variable) %>%
  dplyr::filter(category %in% c("reading","math","writing")) %>%
  dplyr::select(-state)

# add addition columns, needed for drawing with geom_rect
education_donut$fraction = education_donut$value / sum(education_donut$value)
education_donut = education_donut[order(education_donut$fraction), ]
education_donut$ymax = cumsum(education_donut$fraction)
education_donut$ymin = c(0, head(education_donut$ymax, n=-1))

# make the plot
ggplot2::ggplot(education_donut, ggplot2::aes(fill=category, ymax=ymax, ymin=ymin, xmax=4, xmin=3)) +
  ggplot2::geom_rect() +
  ggplot2::coord_polar(theta="y") +
  ggplot2::xlim(c(0, 4)) +
  ggplot2::theme(panel.grid=ggplot2::element_blank()) +
  ggplot2::theme(axis.text=ggplot2::element_blank()) +
  ggplot2::theme(axis.ticks=ggplot2::element_blank()) +
  ggplot2::annotate("text", x = 0, y = 0, label = "Education Components") +
  ggplot2::labs(title="")
```



Pie chart

In [11]:

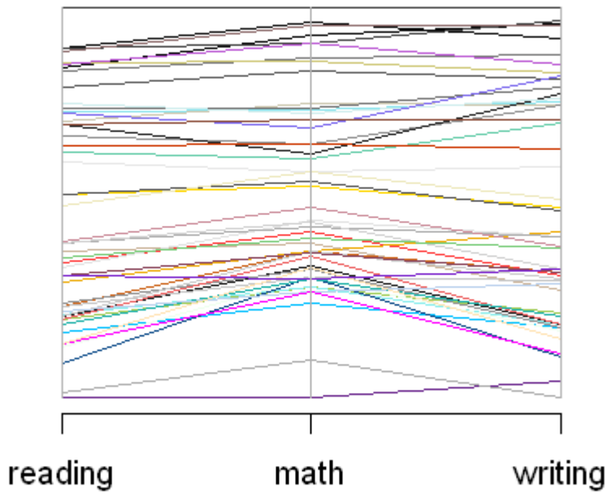
```
# pie chart
slices <- education_donut$value
lbls <- education_donut$category
pie(slices, labels = lbls, main="Education Components")
```



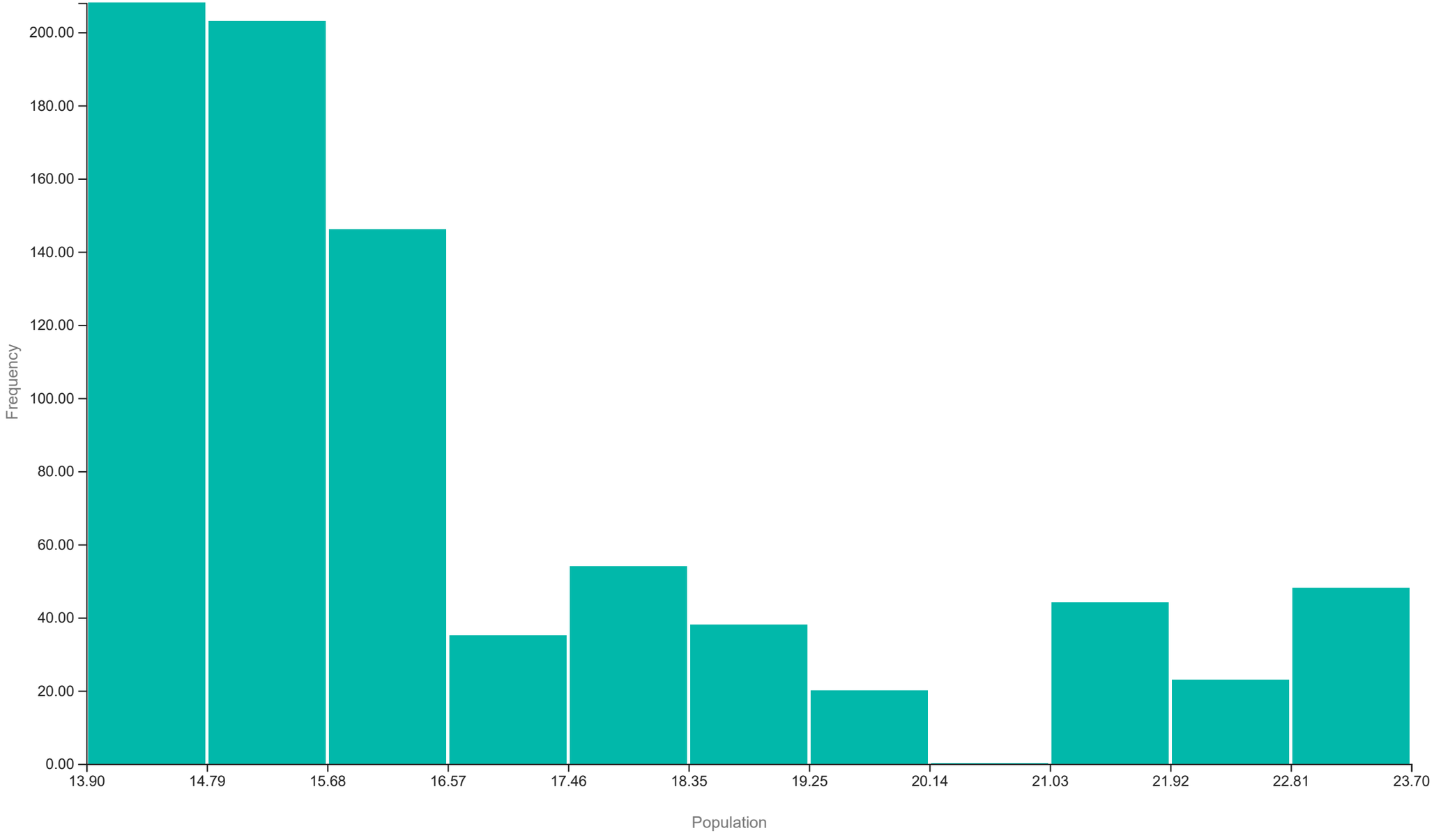
Parallel plot

In [12]:

```
# parallel plot
education_parallel <- education %>%
  dplyr::filter(stringr::str_trim(state, "both") != "United States")

# vector color
my_colors=colors()[as.numeric(education_parallel$state)*11]

# make the graph
MASS::parcoord(education_parallel[,c(2:4)] , col= my_colors  )
```

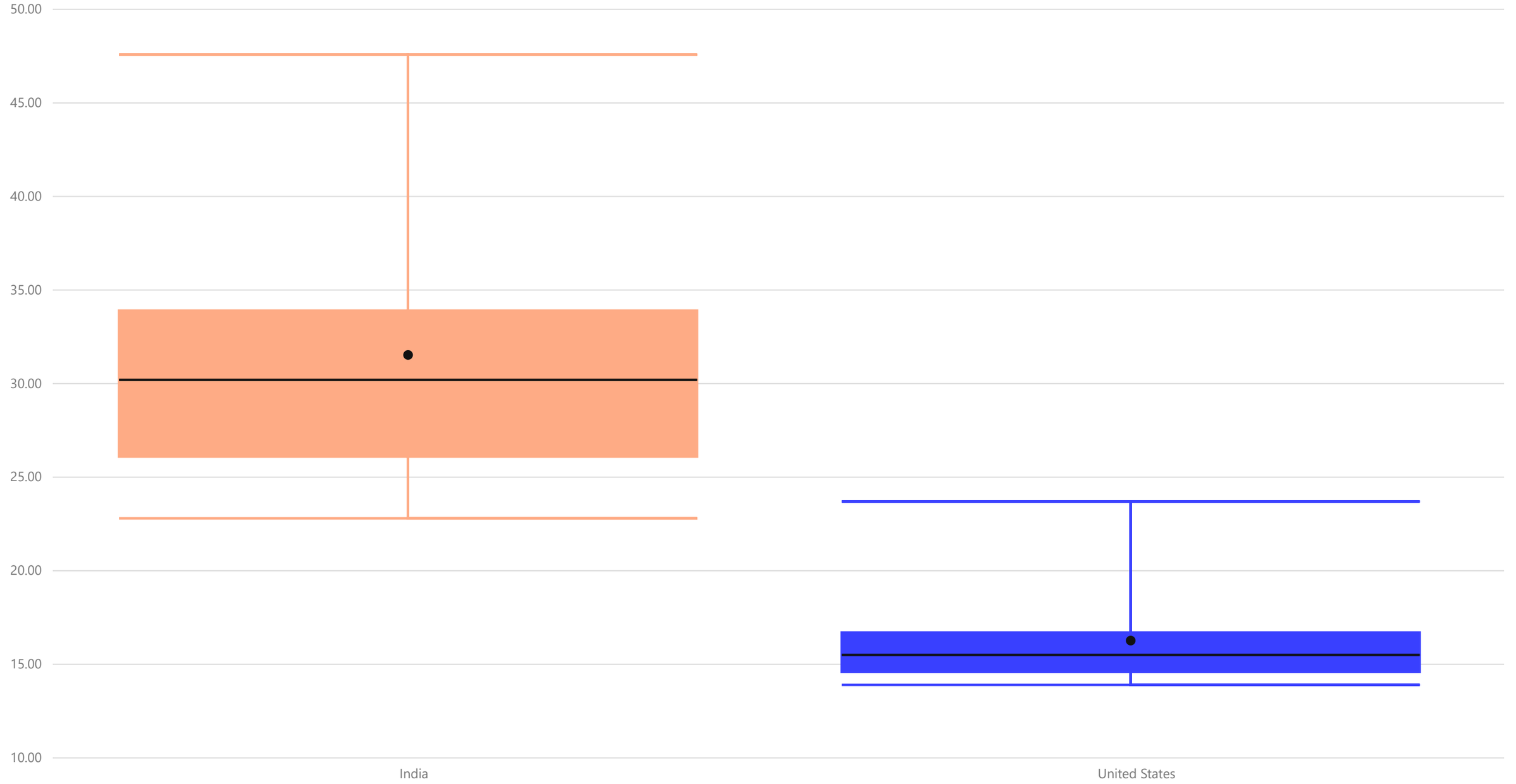

reading
math
writing

USA Population Rate Changes

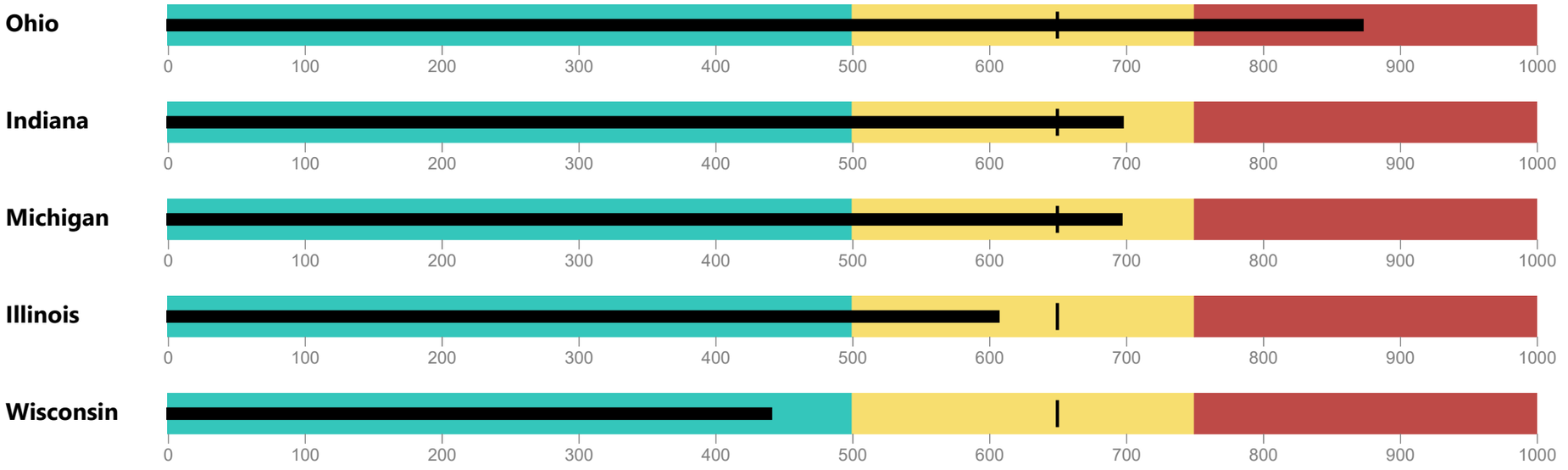


Ceiling value of population has been used to reduce the number of groups

Population sampled over all years for India and USA

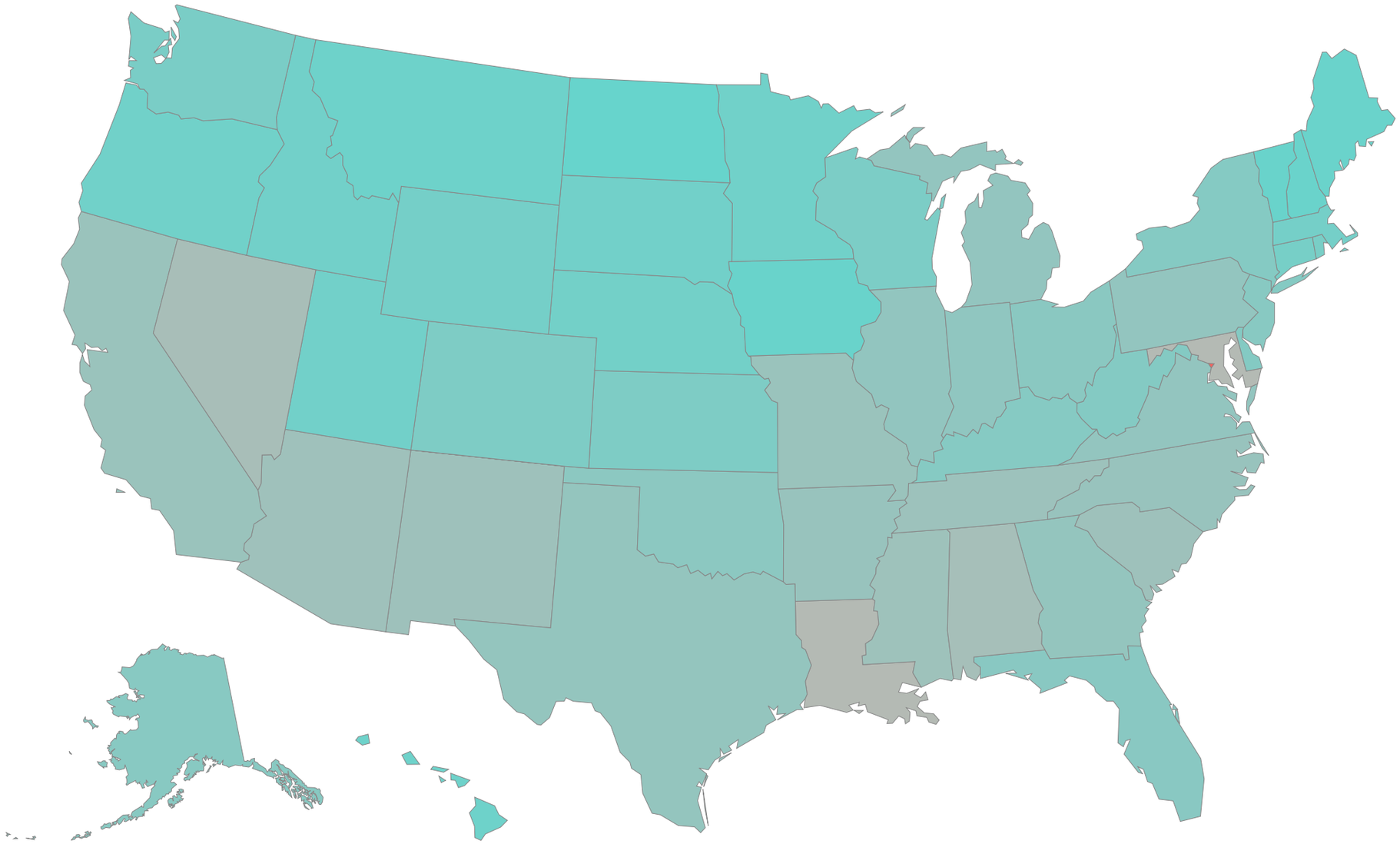


Theft Crime comparison in East North Central States of USA

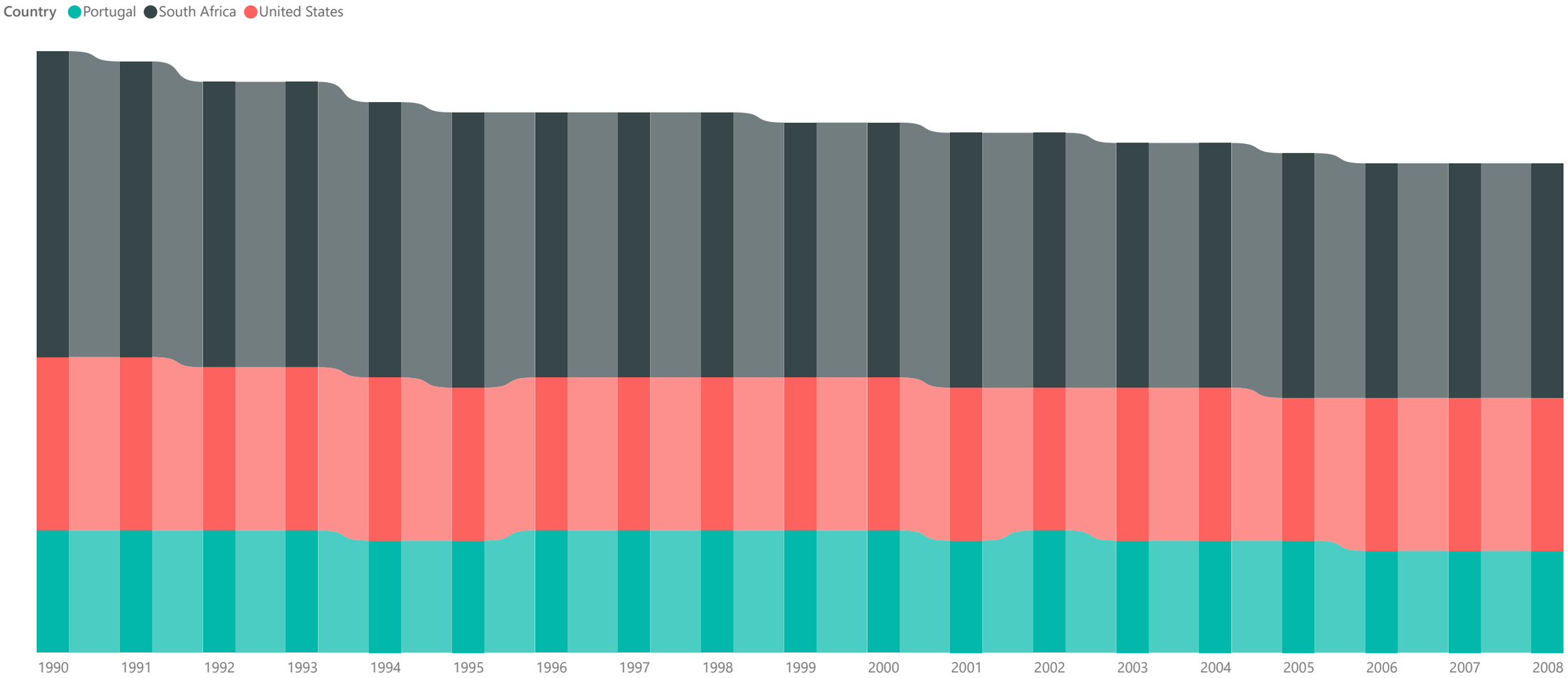


Ohio, Indiana, Michigan and Illinois are the four East North Central states of USA, chosen for the bullet chart, to keep the visualization limited. The green bar shows number of burglary incident marked as 'Safe', yellow represents 'Moderate' and red represents 'Unsafe'. The tick mark is the targeted theft crime index and the black bar is the actual. The further away the bar is from the tick, towards the green part, the safer.

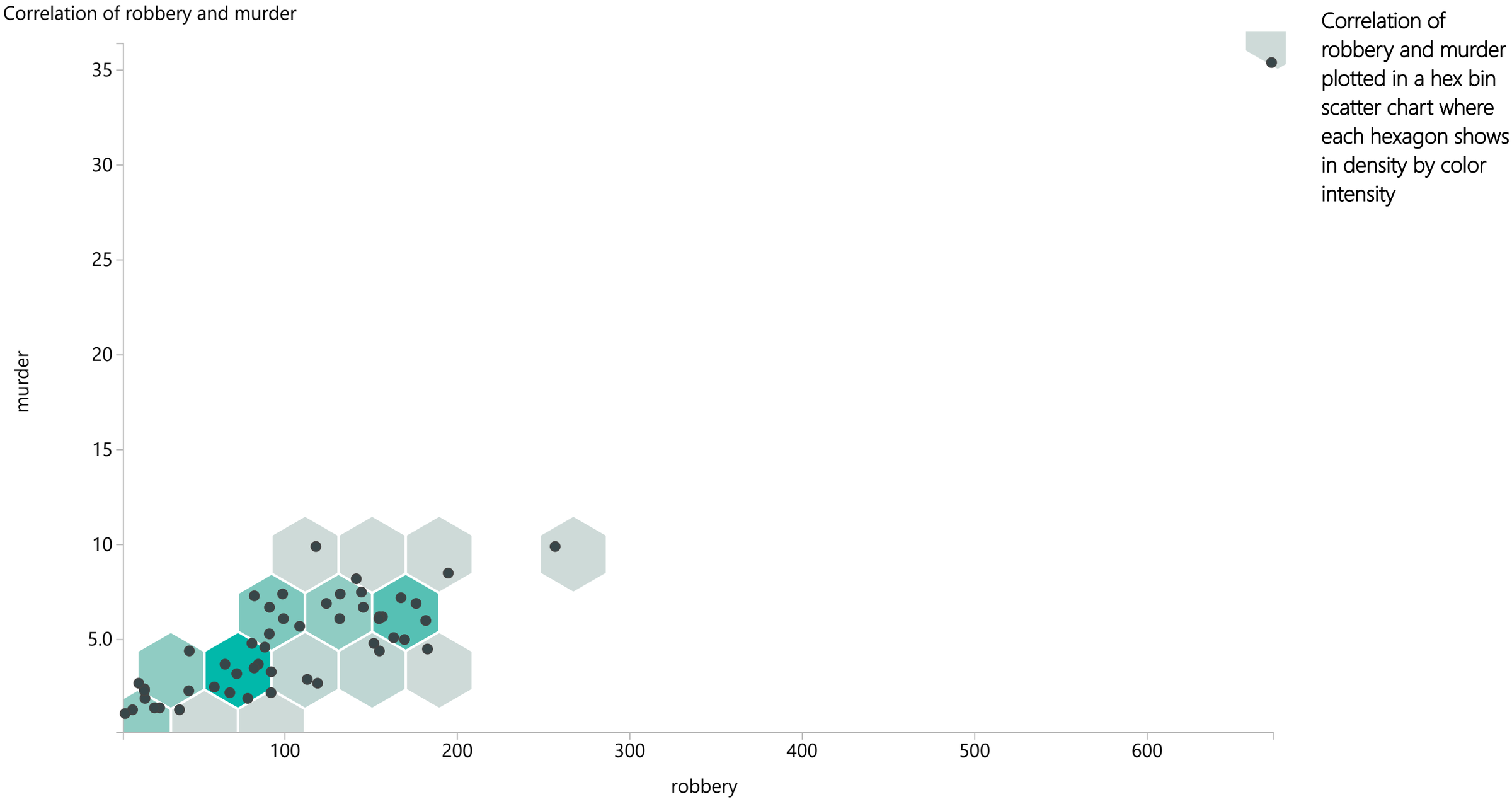
Count of murder crimes by State



Population by Year



Population and population changes over year - Comparison between Portugal, South Africa and USA for the period of 1990 to 2008


Correlation of robbery and murder
Correlation of robbery and murder plotted in a hex bin scatter chart where each hexagon shows in density by color intensity
35
30
25
20
15
10
5.0
murder
100
200
300
400
500
600
robbery