Adding style

INTERACTIVE DATA VISUALIZATION WITH BOKEH

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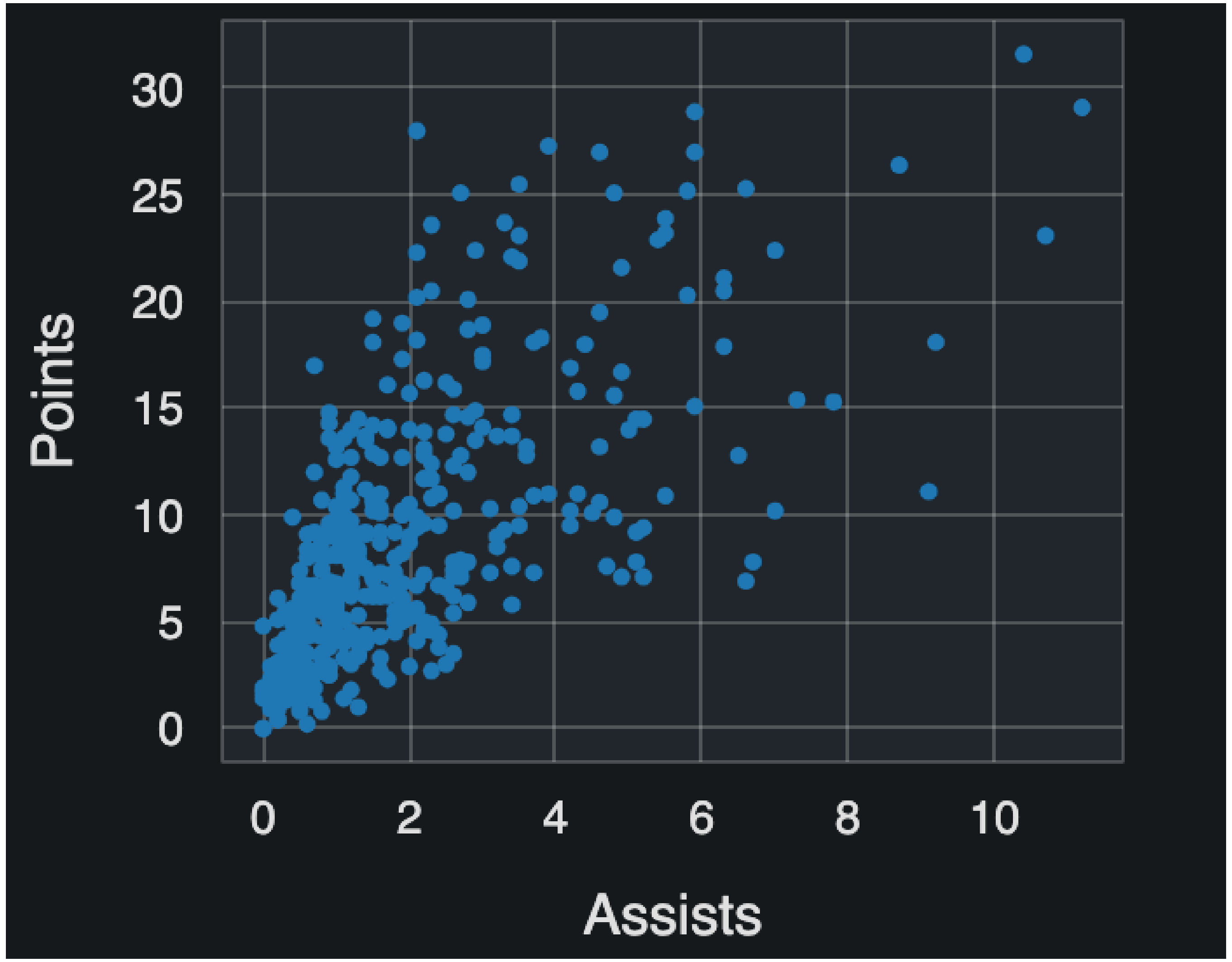
Bokeh themes

- `caliber`
- `dark_minimal`
- `light_minimal`
- `night_sky`
- `contrast`

[1] http://docs.bokeh.org/en/latest/docs/user_guide/styling.html#using-themes

Using themes

```python
from bokeh.io import curdoc
curdoc().theme = "dark_minimal"
fig = figure(x_axis_label="Assists",
             y_axis_label="Points")
fig.circle(x=nba["assists"],
           y=nba["points"])
output_file("dark_minimal.html")
show(fig)
```



Subsetting data

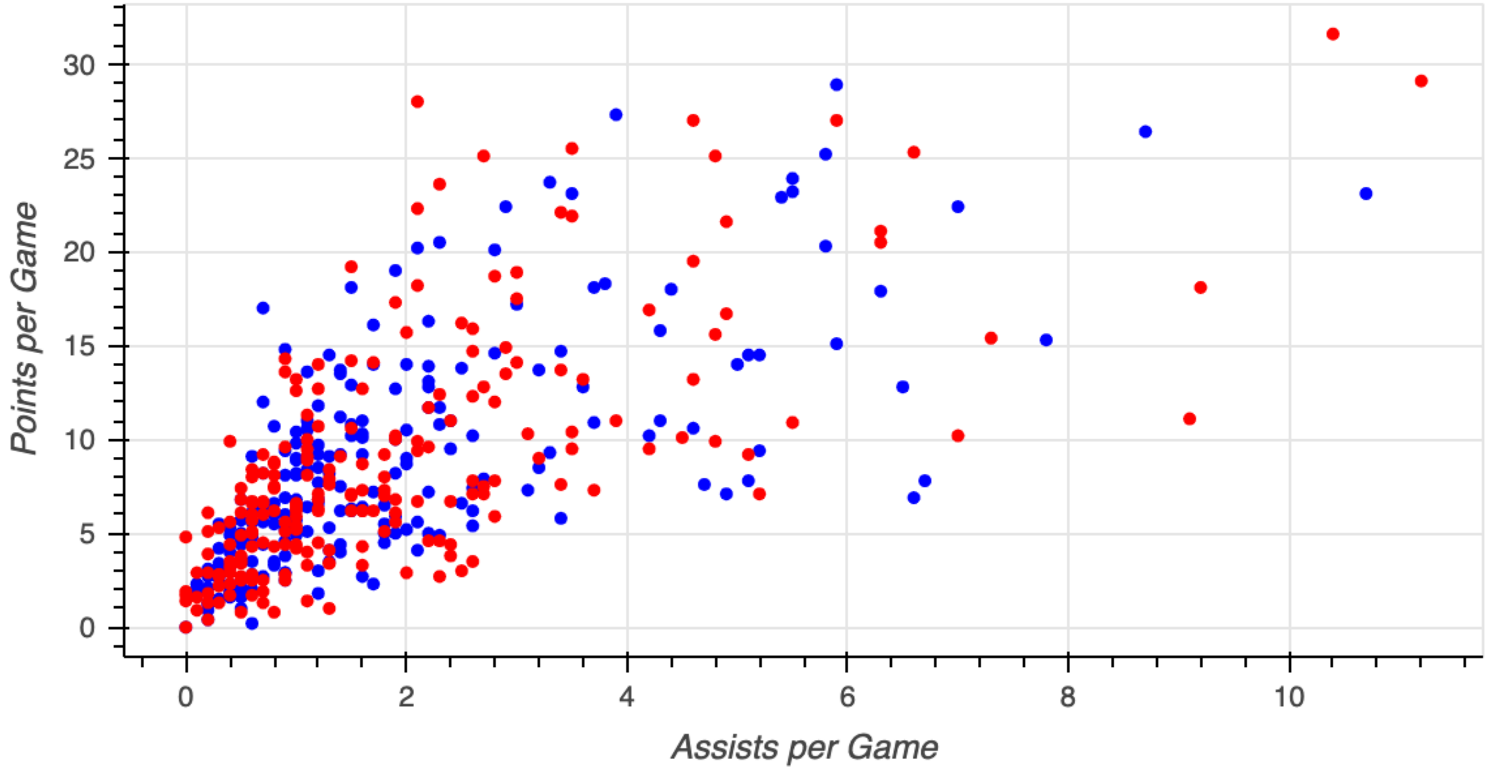
```python
east = nba.loc[nba["conference"] == "East"]
west = nba.loc[nba["conference"] == "West"]
```

```python
print(nba.columns, '\n', east.shape, '\n', west.shape)
```

```
Index(['player', 'position', 'minutes', 'field_goal_perc', 'three_point_perc', 'free_throw_perc',
       'rebounds', 'assists', 'steals', 'blocks', 'points', 'team', 'conference'],
        dtype='object')
(211, 13)
(215, 13)
```

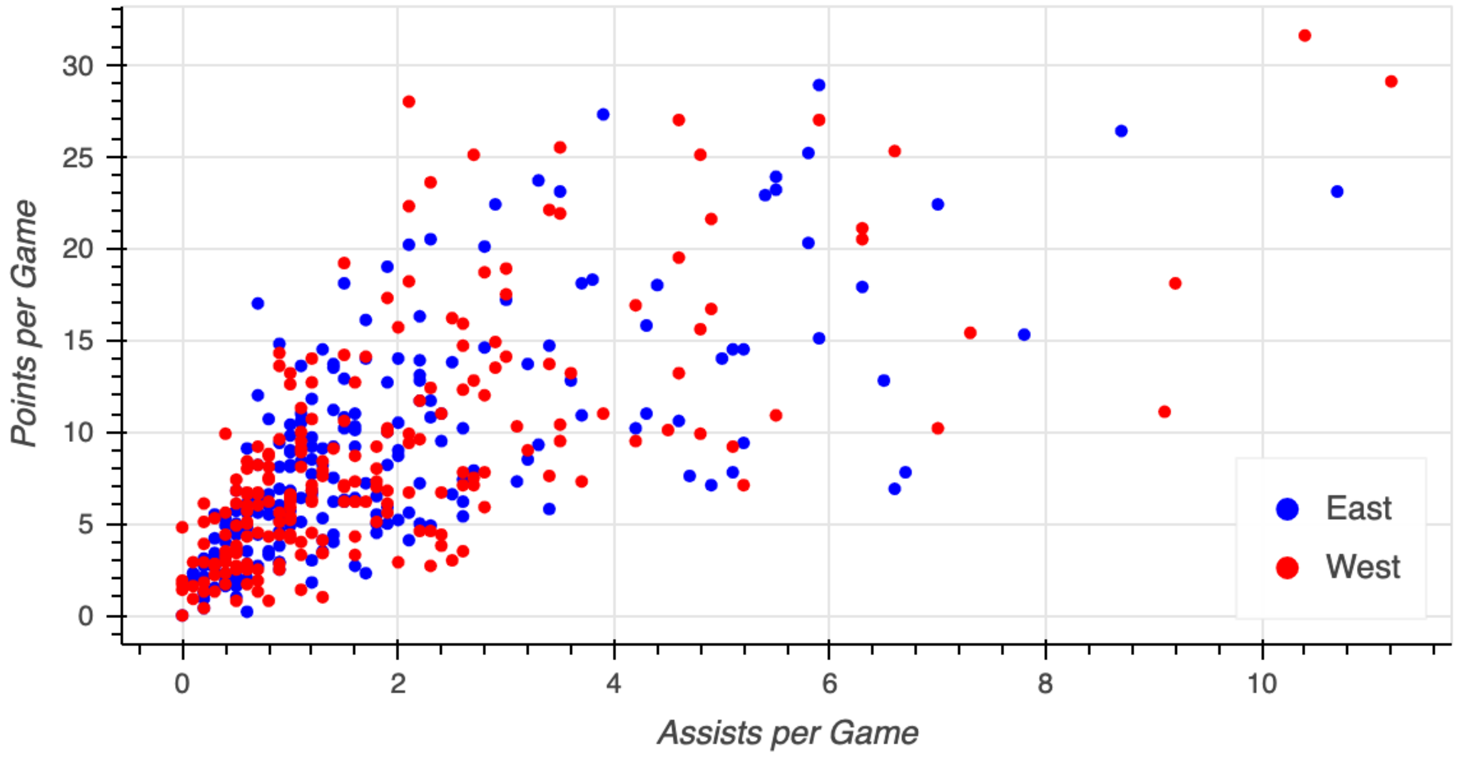
Customizing color

```
fig = figure(x_axis_label="Assists per Game", y_axis_label="Points per Game")
fig.circle(x=east["assists"], y=east["points"], color="blue")
fig.circle(x=west["assists"], y=west["points"], color="red")
output_file(filename="east_vs_west.html")
show(fig)
```



Adding a legend

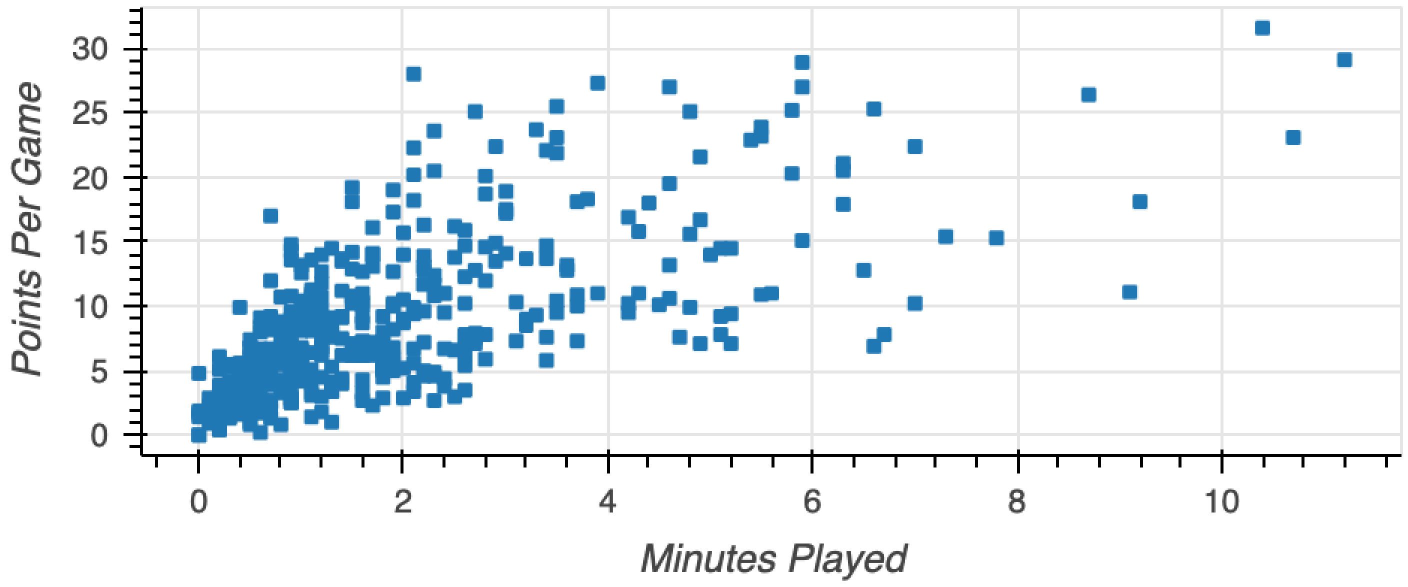
```
fig = figure(x_axis_label="Assists per Game", y_axis_label="Points per Game")
fig.circle(x=east["assists"], y=east["points"], color="blue", legend_label="East")
fig.circle(x=west["assists"], y=west["points"], color="red", legend_label="West")
output_file(filename="east_vs_west_with_legend.html")
show(fig)
```



Glyph types

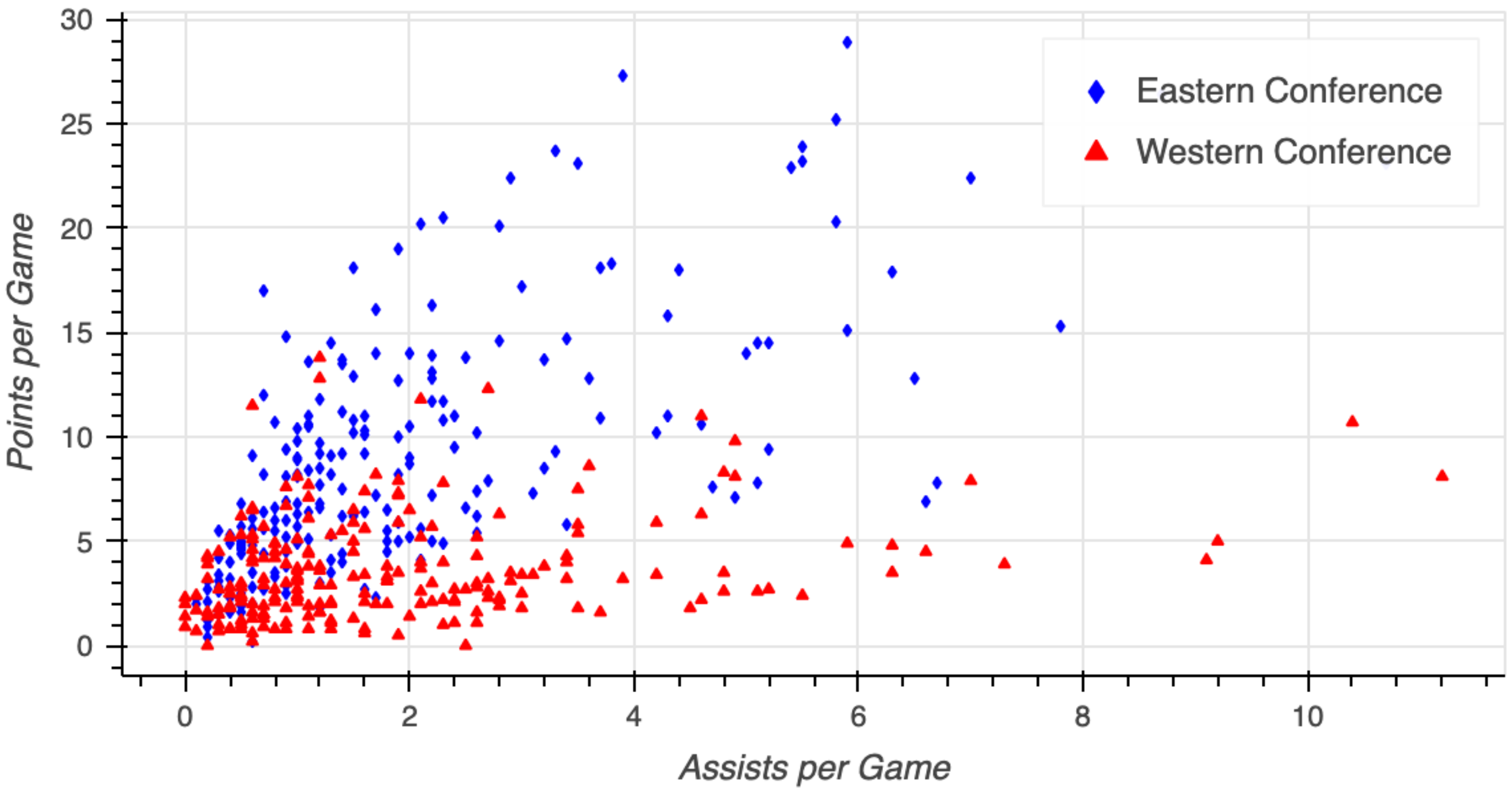
- square
  - □
- triangle
  - △
- diamond
  - ◇

```
fig = figure(x_axis_label='Minutes Played',
             y_axis_label="Points Per Game")
fig.square(x=nba["minutes_played"],
           y=nba["points_per_game"])
output_file(filename="nba_points.html")
show(fig)
```



Multiple glyphs

```
fig = figure(x_axis_label="Assists per Game", y_axis_label="Points per Game")
fig.diamond(x=east["assists"], y=east["points"], color="blue", legend_label="Eastern Conference")
fig.triangle(x=west["assists"], y=west["points"], color="red", legend_label="Western Conference")
output_file(filename="multiple_glyphs.html")
show(fig)
```



The dataset

```python
print(melb.columns)
```

```
Index(['rooms', 'type', 'price', 'date', 'distance', 'bedrooms', 'bathrooms',
       'car', 'land_area', 'building_area', 'year_built', 'council_area',
       'region'],
      dtype='object')
```

```python
print(melb.shape)
```

```
(13580, 13)
```

Let's practice!

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Customizing axes

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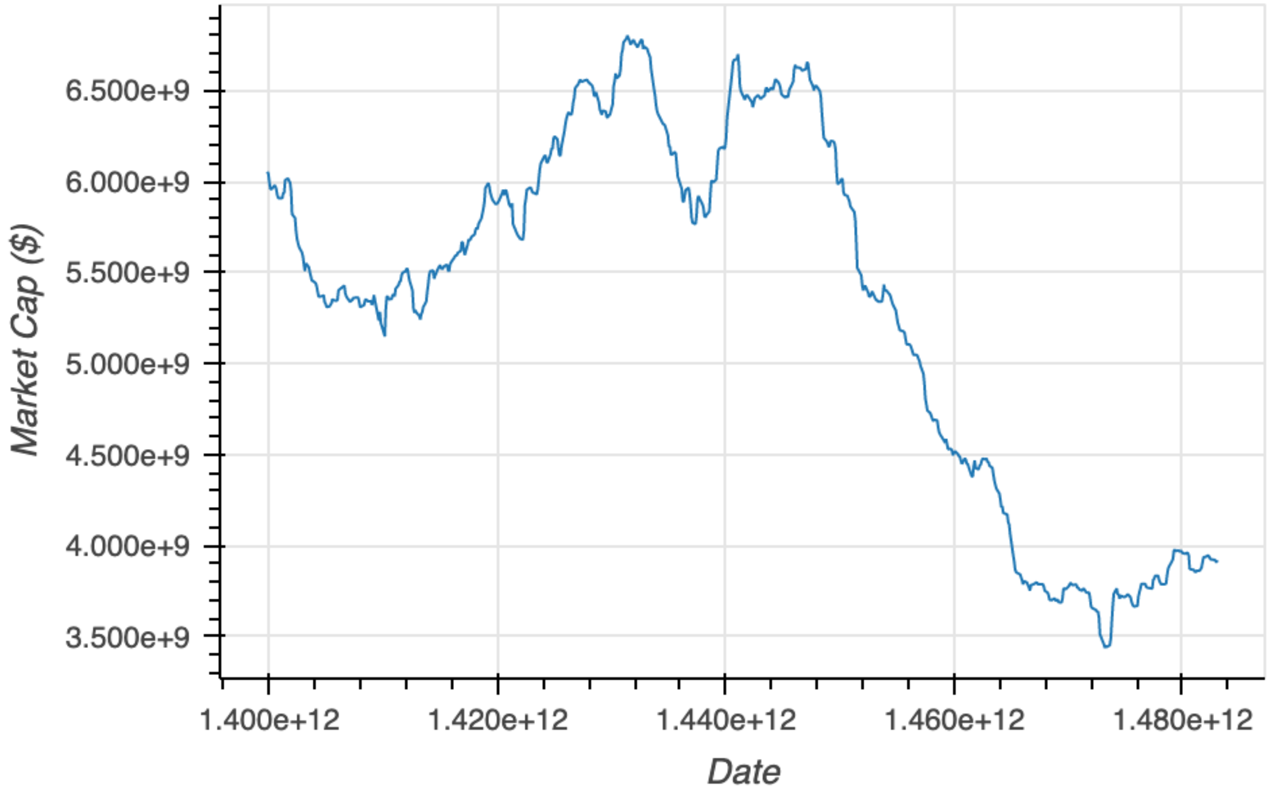
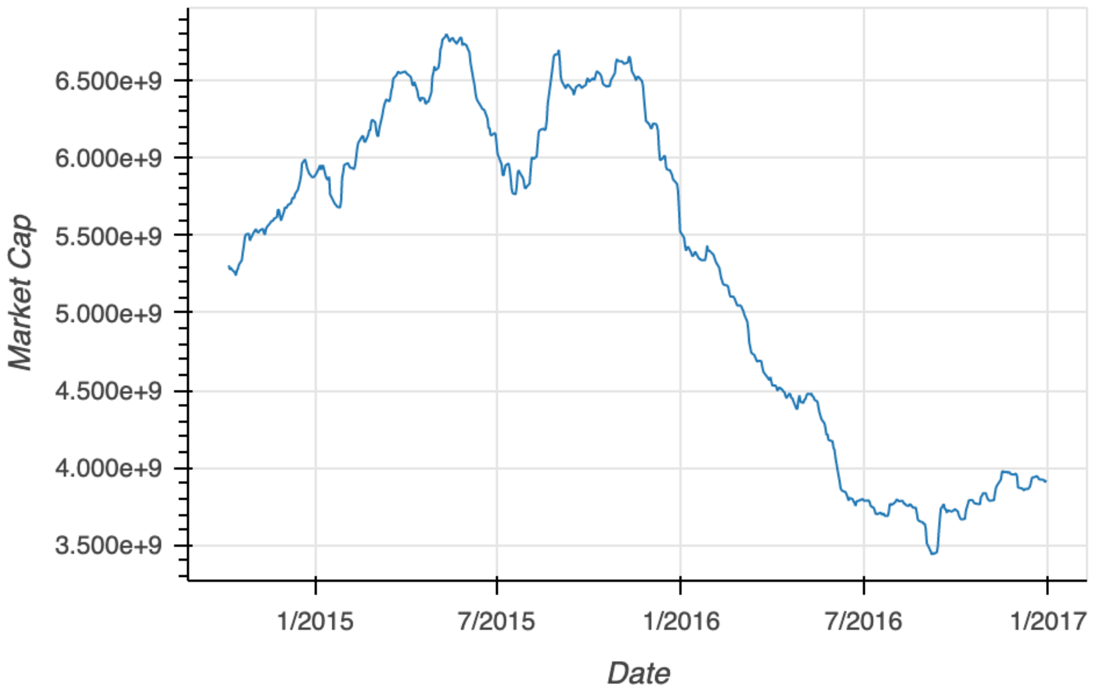
A line plot

```
source = ColumnDataSource(data=apple)
fig = figure(x_axis_label="Date", y_axis_label="Market Cap ($)")
fig.line(x="date", y="market_cap", source=source)
output_file(filename="unformatted_plot.html")
show(fig)
```



X-axis type

```
source = ColumnDataSource(data=apple)
fig = figure(x_axis_label="Date", y_axis_label="Market Cap ($)",
             x_axis_type="datetime")
fig.line(x="date", y="market_cap", source=source)
output_file(filename="unformatted_plot.html")
show(fig)
```



Formatting options

- **NumeralTickFormatter**
- Argument: `format`

Value	format	Output
`1500.00`	`"$0.00"`	`$1500.00`
`2000.00`	`"$0"`	`$2000`
`5000.00`	`"$0,0"`	`$5,000`
`1100000`	`"$0.0a"`	`$1.1m`
`5000000000`	`"$0a`	`$5b`

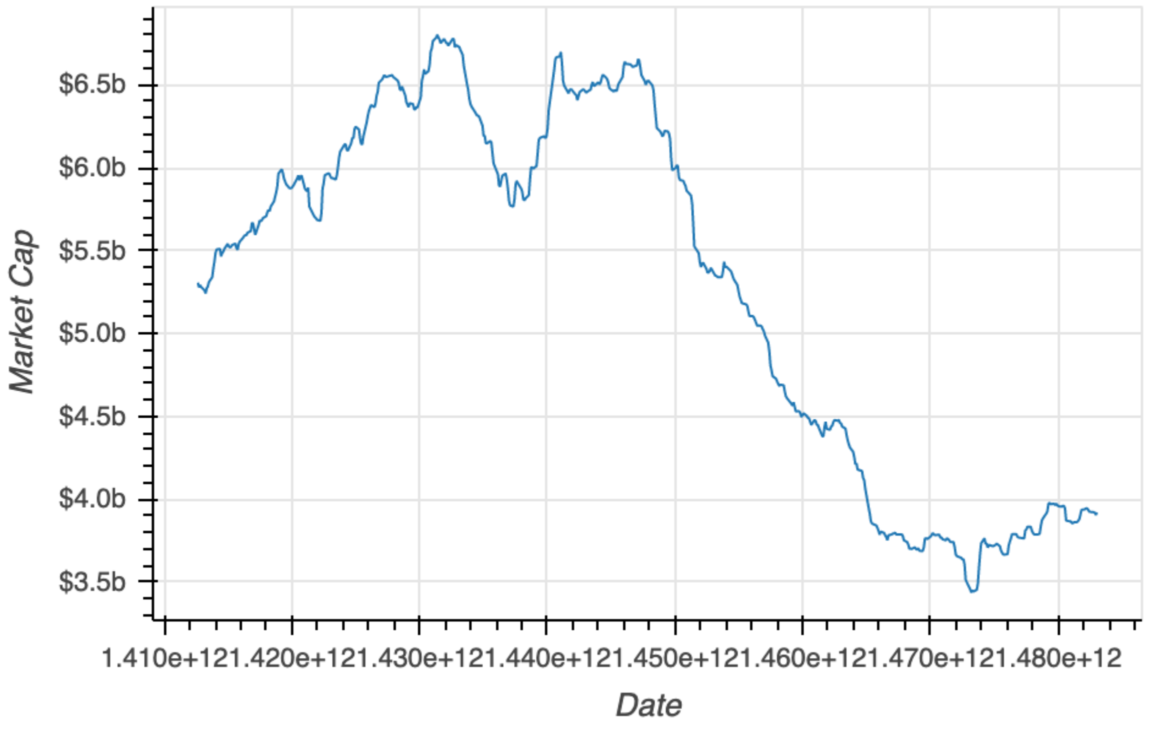
- **DatetimeTickFormatter**
- Argument: `months`

Value	months	Output
`"2018-03-01"`	`"%B %Y"`	`"March 2018"`
`"2019-10-15"`	`"%b %Y"`	`"Oct 2019"`
`"2020-02-09"`	`"%b %y"`	`"Feb 20"`

- Other arguments:
  - `microseconds` , `milliseconds` , `seconds` , `minisec` , `minutes` , `hourmin` , `hours` , `days` , `years`

NumeralTickFormatter

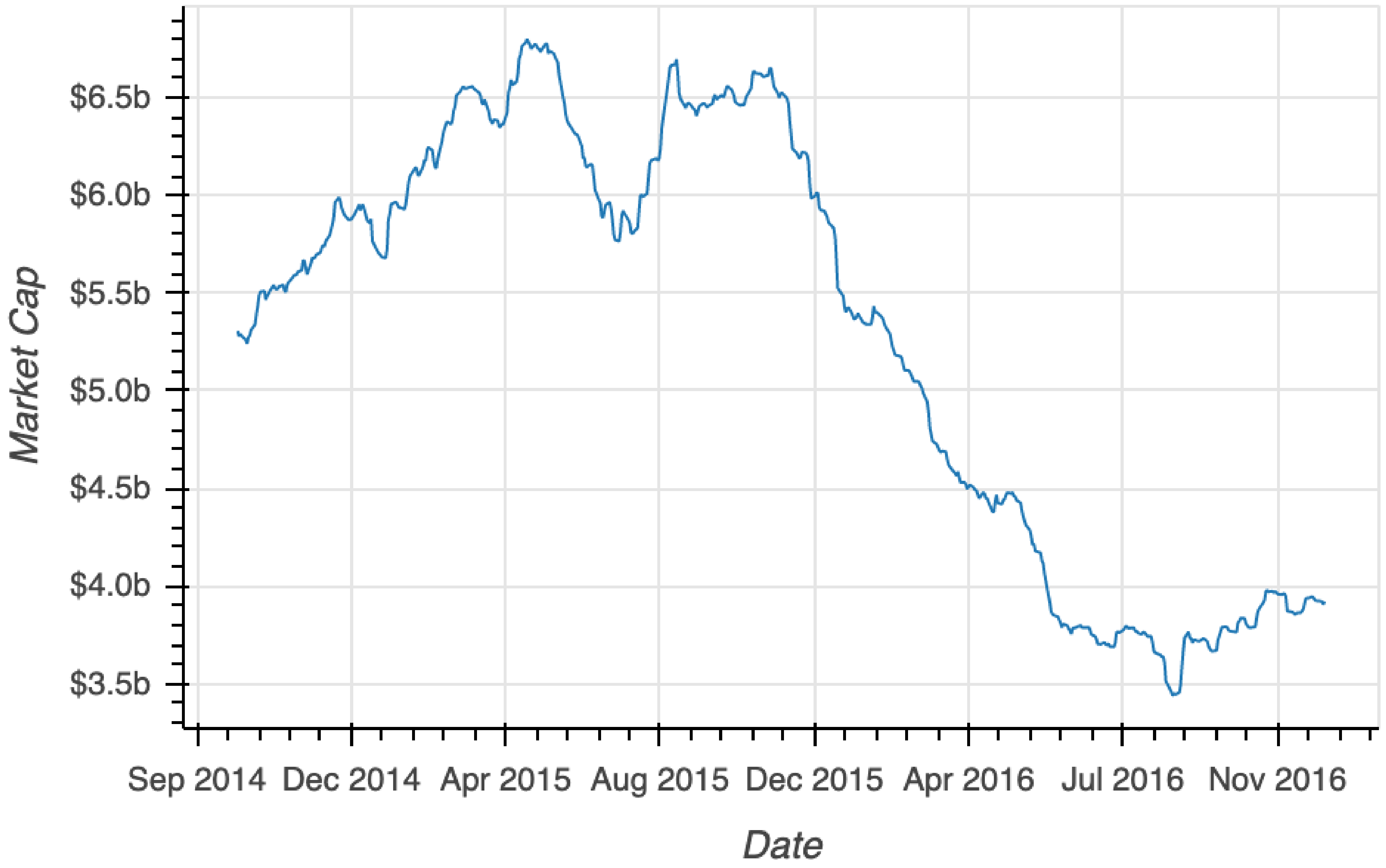
```
from bokeh.models import NumeralTickFormatter
fig = figure(x_axis_label="Date", y_axis_label="Price ($)")
fig.line(x="date", y="market_cap", source=source)
fig.yaxis[0].formatter = NumeralTickFormatter(format="$0.0a")
output_file(filename="formatted_y_axis.html")
show(fig)
```



DatetimeTickFormatter

```python
from bokeh.models import NumeralTickFormatter, DatetimeTickFormatter
fig = figure(x_axis_label="Date", y_axis_label="Price ($)")
fig.line(x="date", y="price", source=source)
fig.yaxis[0].formatter = NumeralTickFormatter(format="$0.0a")
fig.xaxis[0].formatter = DatetimeTickFormatter(months="%b %Y")
output_file(filename="formatted_market_cap.html")
show(fig)
```

The final plot



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Subplots

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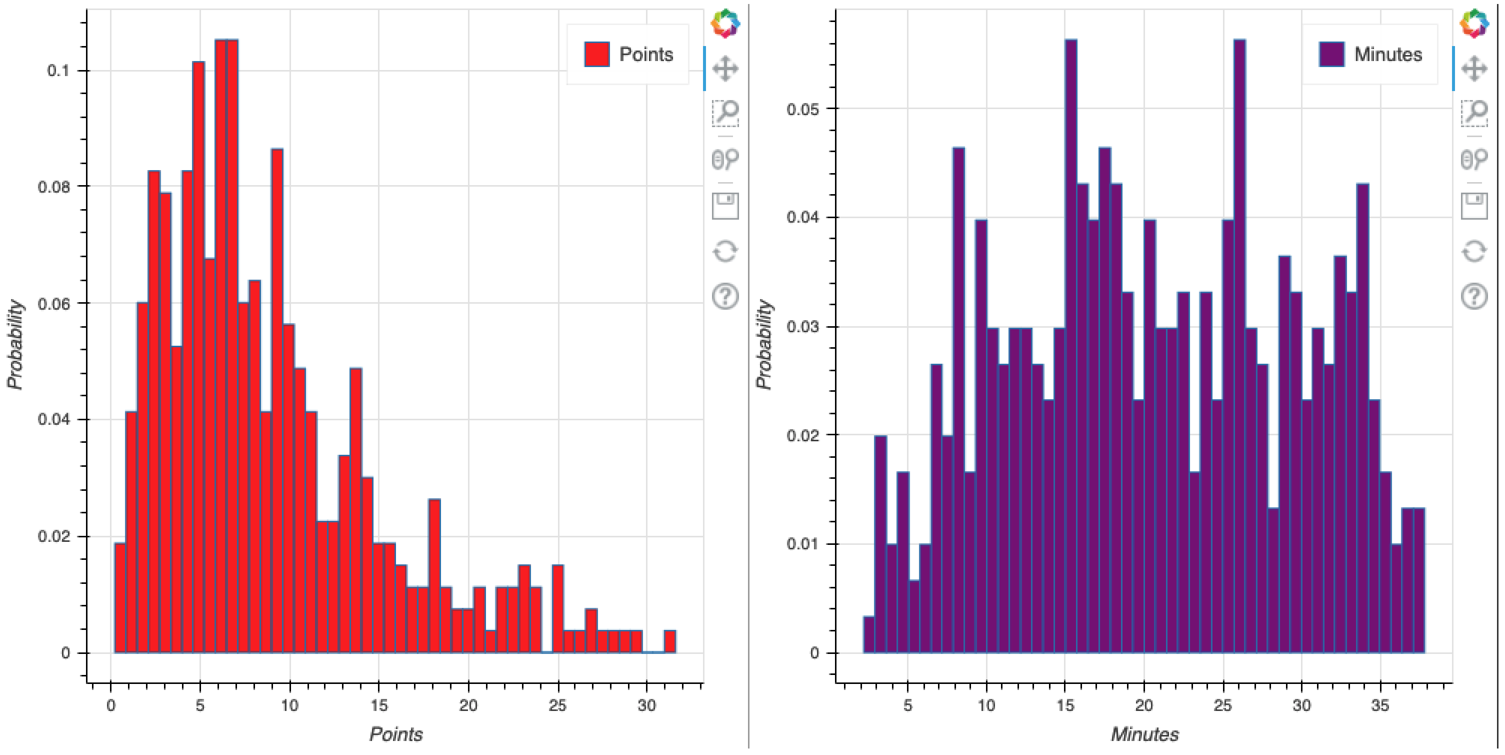
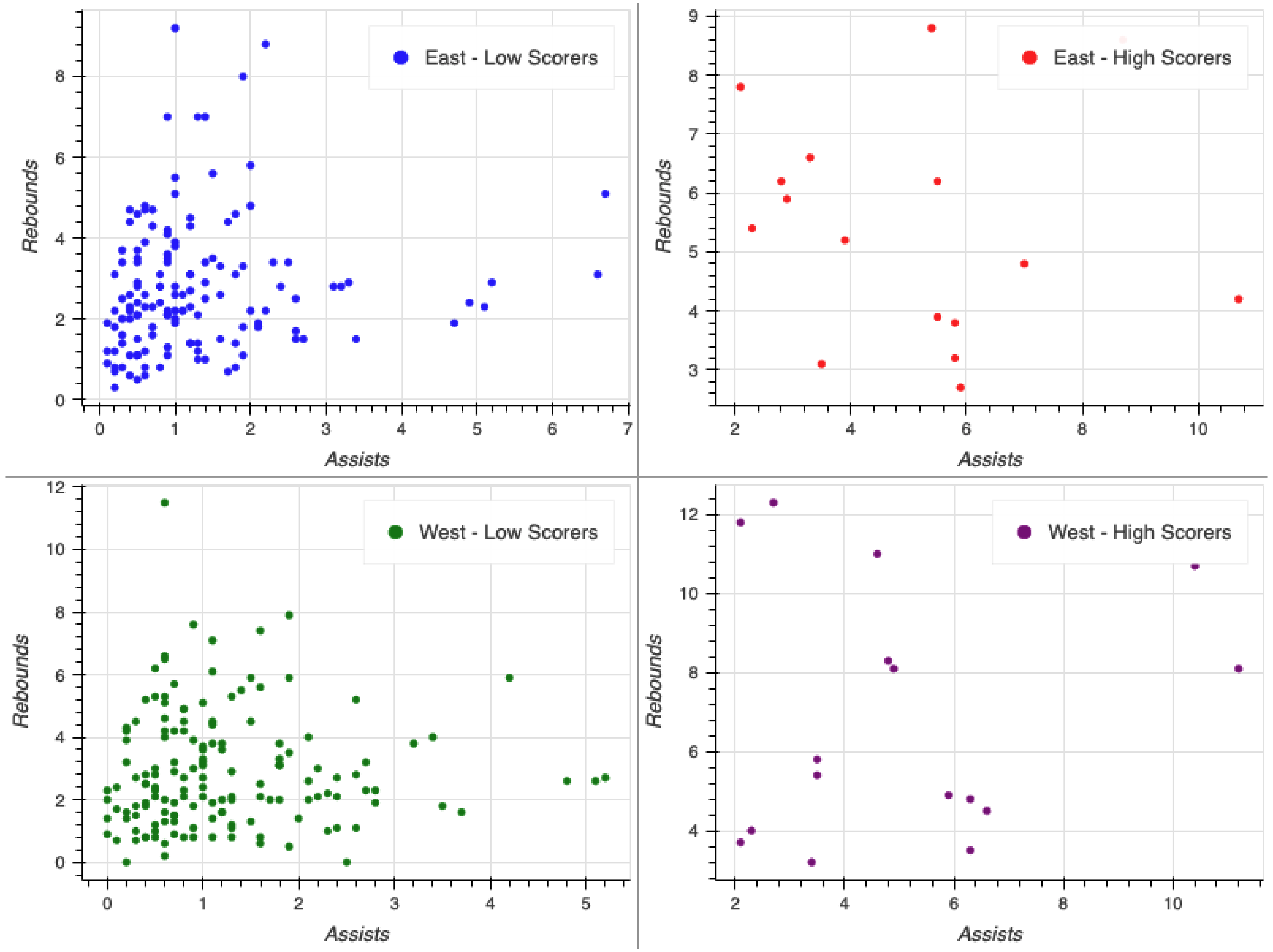
Why use subplots?

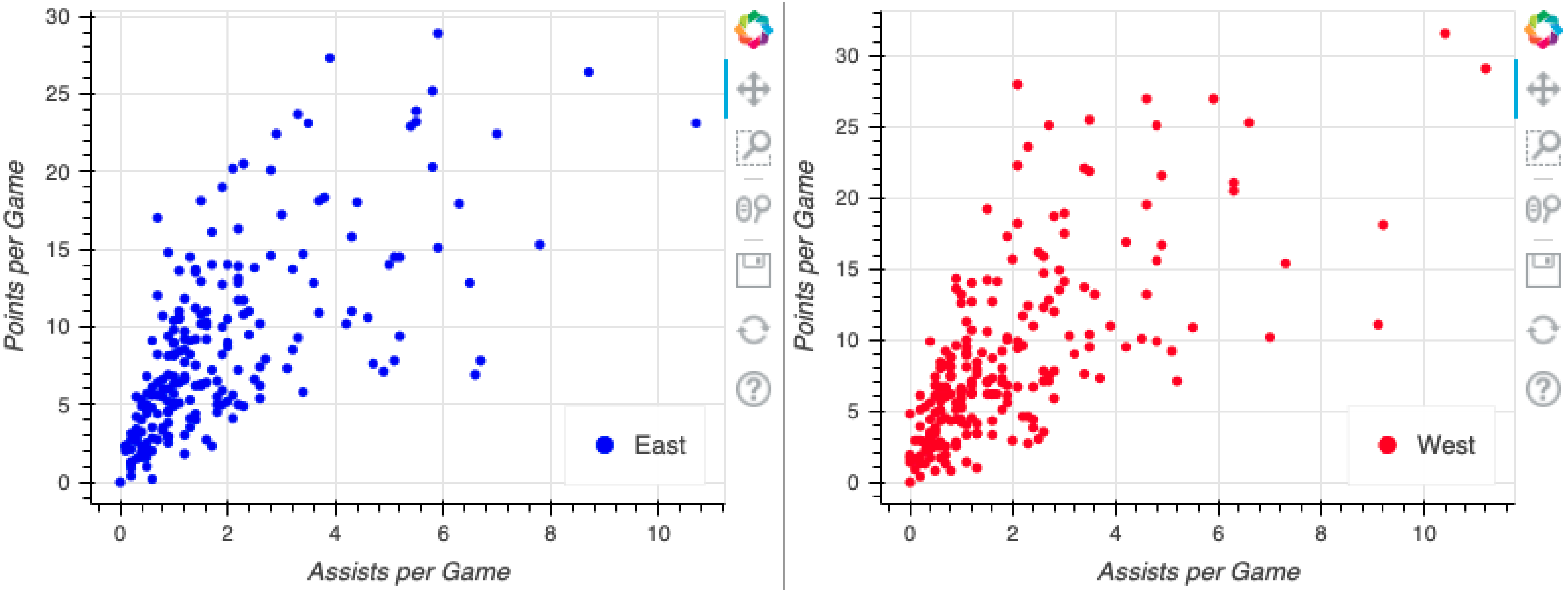




Building a row

```python
from bokeh.layouts import row
east_source = ColumnDataSource(data=east)
west_source = ColumnDataSource(data=west)
fig_one = figure(x_axis_label="Assists per Game", y_axis_label="Points per Game")
fig_two = figure(x_axis_label="Assists per Game", y_axis_label="Points per Game")
fig_one.circle(x="assists", y="points", source=east_source, color="blue", legend_label="East")
fig_two.circle(x="assists", y="points", source=west_source, color="blue", legend_label="West")
output_file(filename="row_plots.html")
show(row(fig_one, fig_two))
```

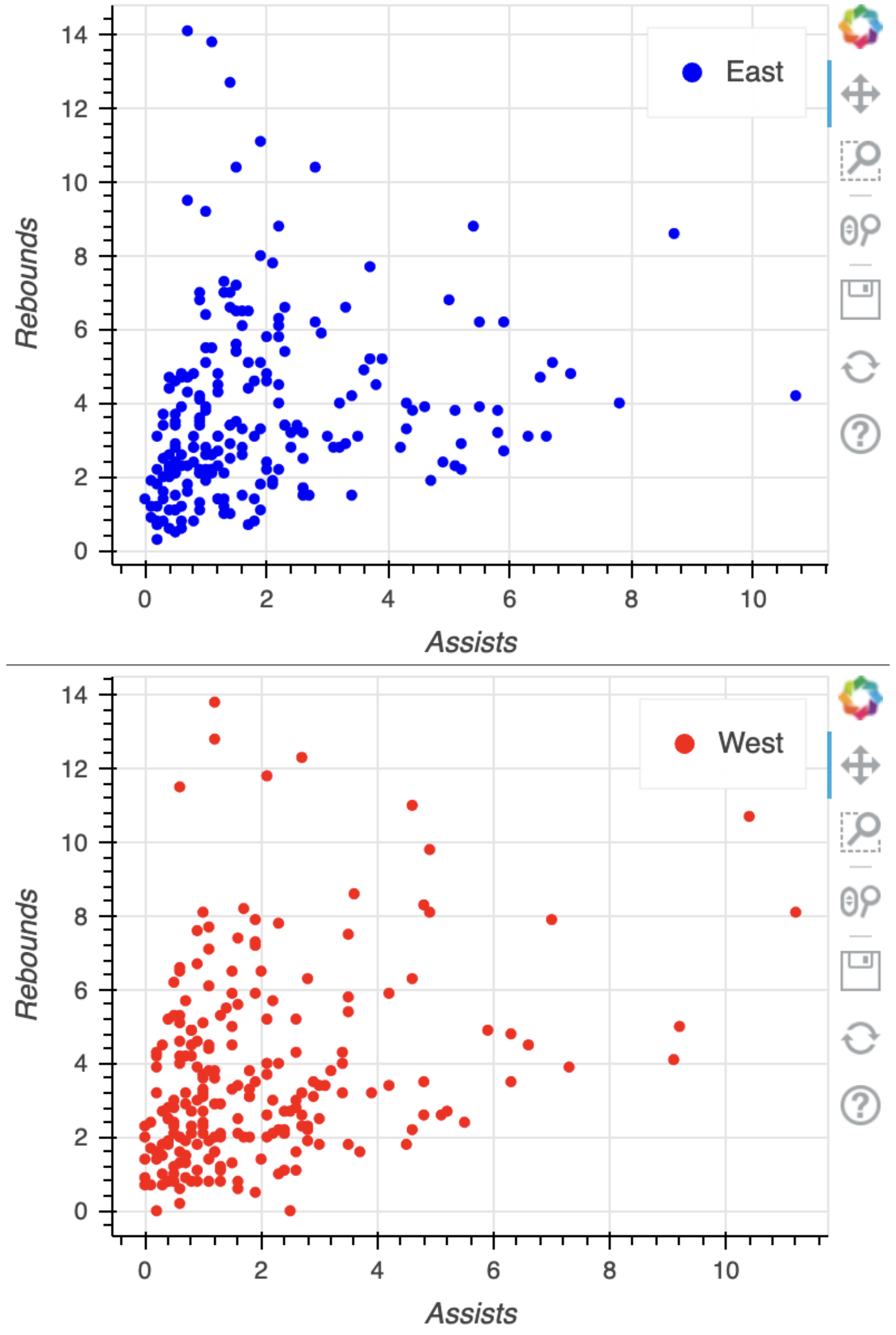
Row subplot



30
25
20
15
10
5
0
Points per Game
0
2
4
6
8
10
Assists per Game
● East
30
25
20
15
10
5
0
Points per Game
0
2
4
6
8
10
Assists per Game
● West

Column subplot

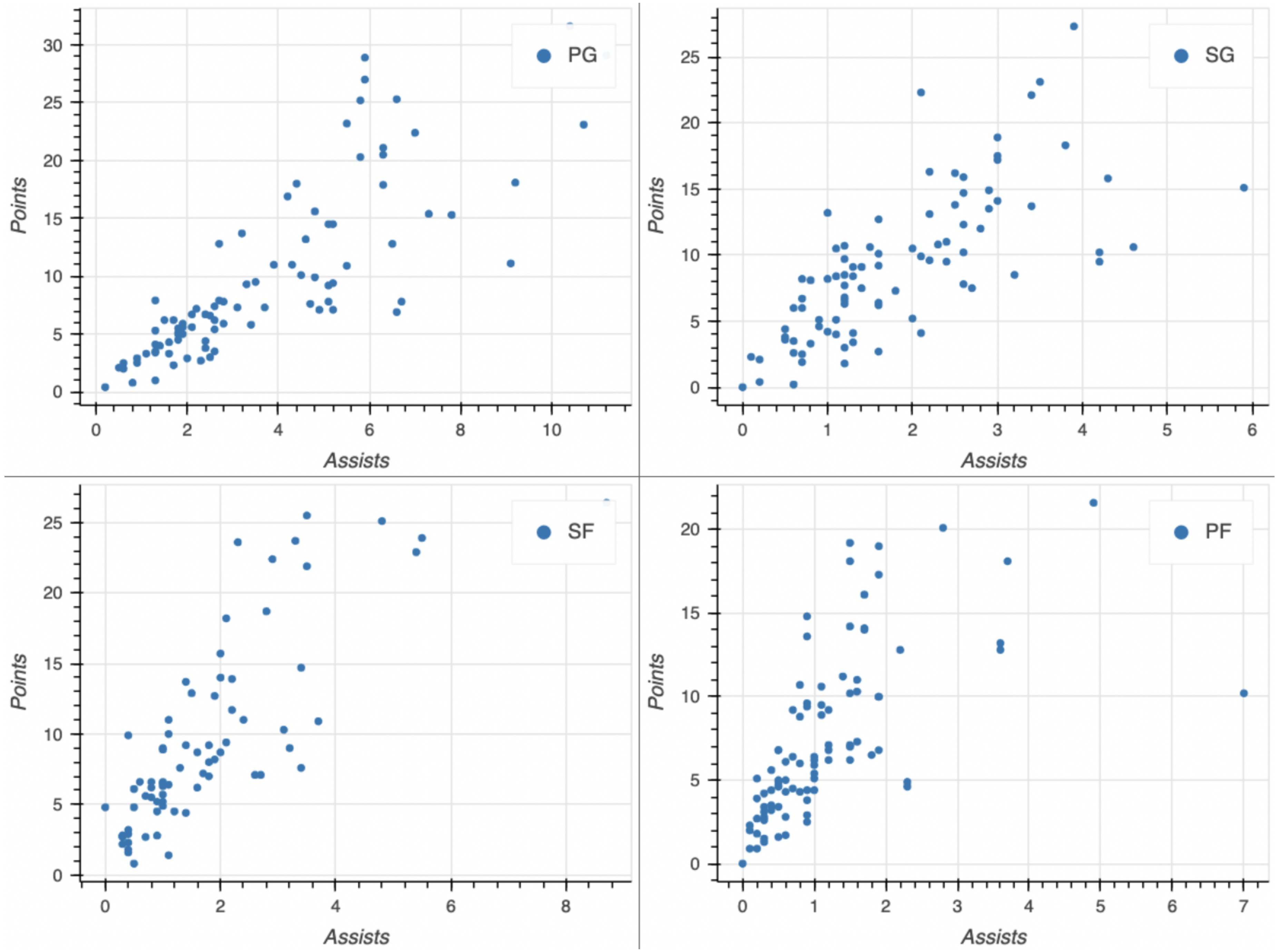
```
from bokeh.layouts import column
fig_one = figure(x_axis_label="Assists",
                 y_axis_label="Rebounds")
fig_two = figure(x_axis_label="Assists",
                 y_axis_label="Rebounds")
fig_one.circle(x="assists", y="rebounds",
               source=east_source,
               color="blue", legend_label="East")
fig_two.circle(x="assists", y="rebounds",
               source=east_source,
               color="blue", legend_label="East")
output_file(filename="column_plots.html")
show(column(fig_one, fig_two))
```



Building a gridplot

```python
from bokeh.layouts import gridplot
positions = ["PG", "SG", "SF", "PF"]
plots = []
for position in positions:
  nba_positions = nba.loc[nba["position"] == position]
  source = ColumnDataSource(data=nba_positions)
  fig = figure(x_axis_label="Assists", y_axis_label="Points")
  fig.circle(x="assists", y="points", source=source, legend_label=position)
  plots.append(fig)
output_file(filename="nba_gridplot.html")
show(gridplot(plots, ncols=2))
```

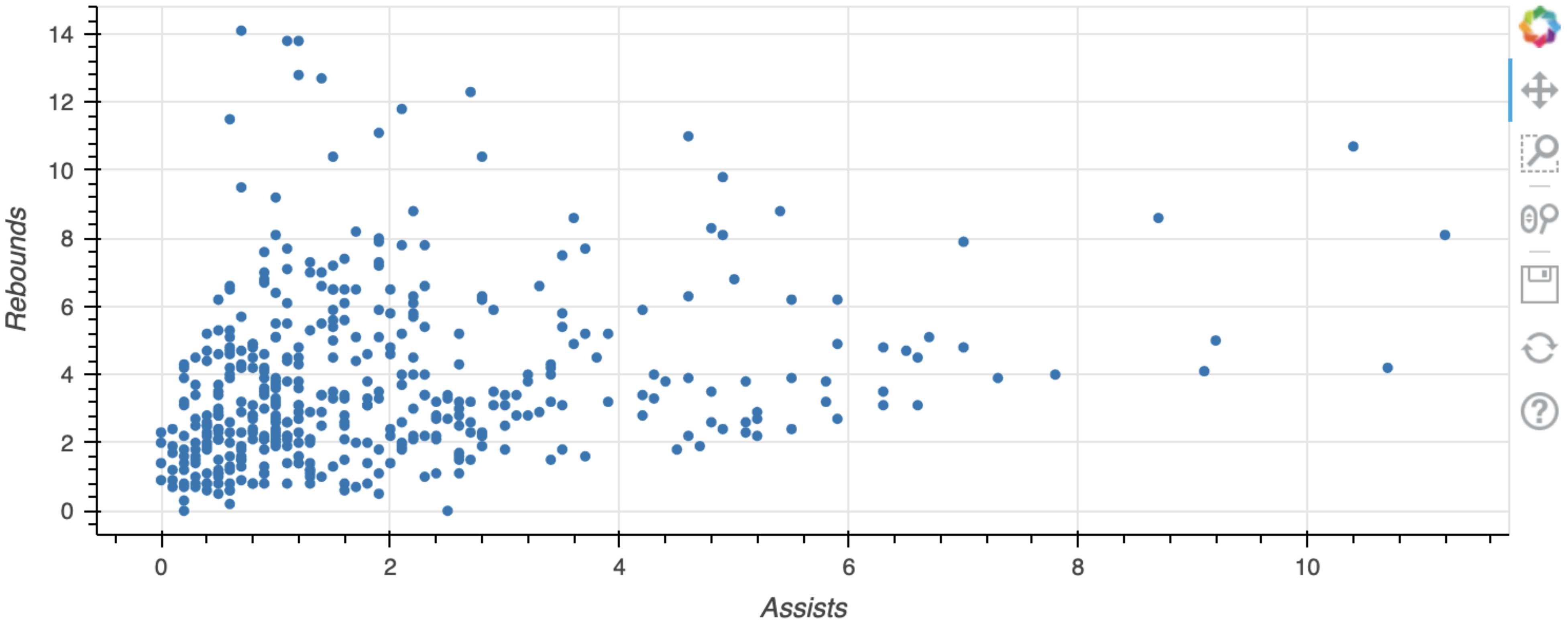
Gridplot



● PG
Points
Assists
0
5
10
15
20
25
30
0
2
4
6
8
10
● SG
Points
Assists
0
5
10
15
20
25
0
1
2
3
4
5
6
● SF
Points
Assists
0
5
10
15
20
25
0
2
4
6
8
● PF
Points
Assists
0
5
10
15
20
0
1
2
3
4
5
6
7

Customizing figure size

```
fig = figure(x_axis_label="Assists", y_axis_label="Rebounds",
             width=750, height=300)
fig.circle(x="assists", y="rebounds", source=source)
output_file(filename="custom_size_plot.html")
show(fig)
```



Let's practice!

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Visualizing categorical data

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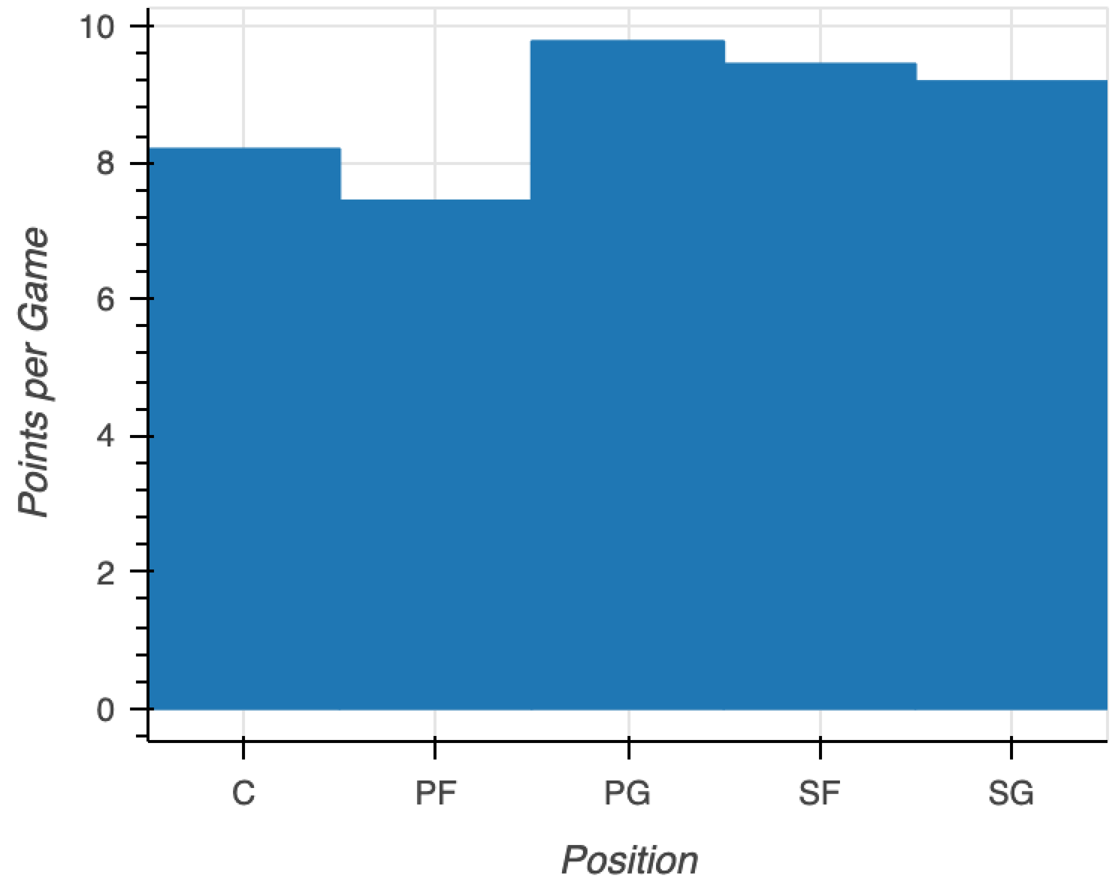
Categorical data

- Categorical data is any data with a fixed number of options or labels.
  - Examples include gender or country of birth.
- Factors are another term for categorical variables

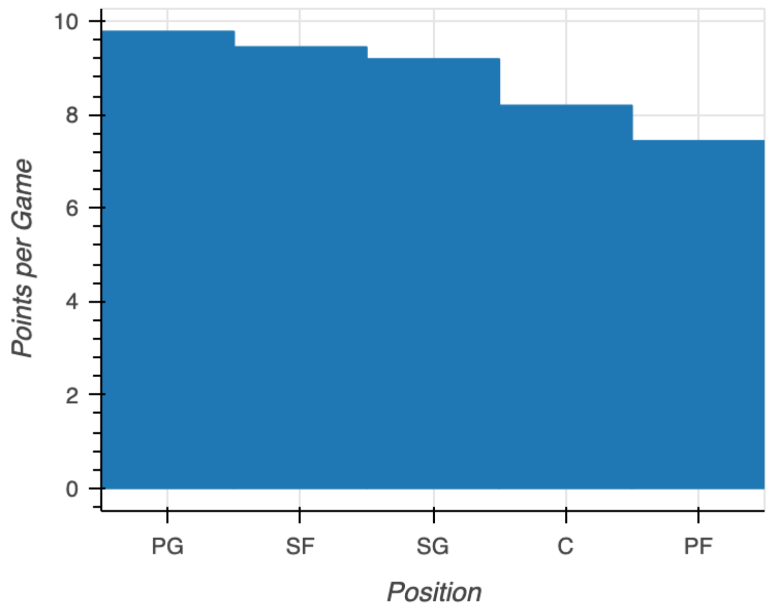
```python
print(nba[["position", "team", "conference"]].head())
```

```
    position    team    conference
0   PG          OKC     West
1   PG          HOU     West
2   PG          BOS     East
3   C           NO      West
4   SG          TOR     East
```

Sorting

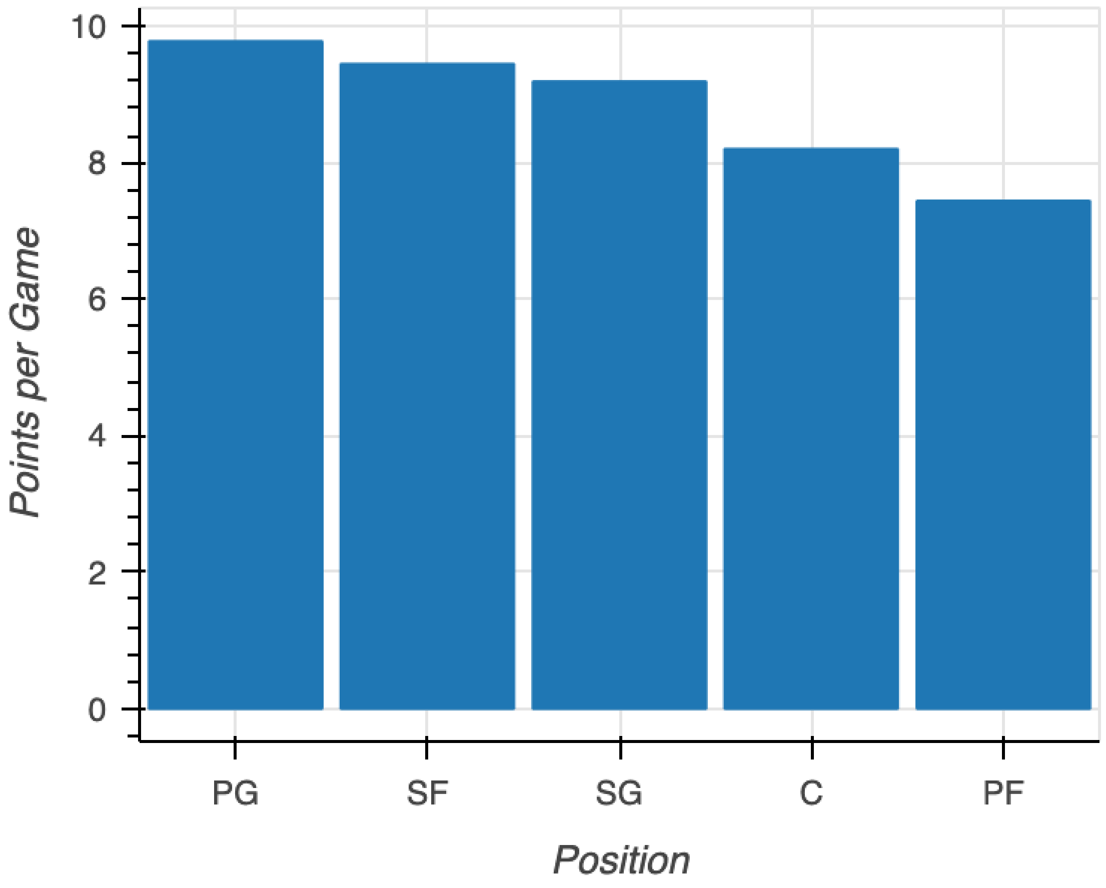


```
pos = nba.groupby("position")["points"].mean()
pos = pos.sort_values("points", ascending=False)
fig = figure(x_range=pos["position"],
             x_axis_label="Position",
             y_axis_label="Points per Game")
fig.vbar(x=pos["position"], top=pos["points"])
output_file(filename="sorted_plot.html")
show(fig)
```



Padding

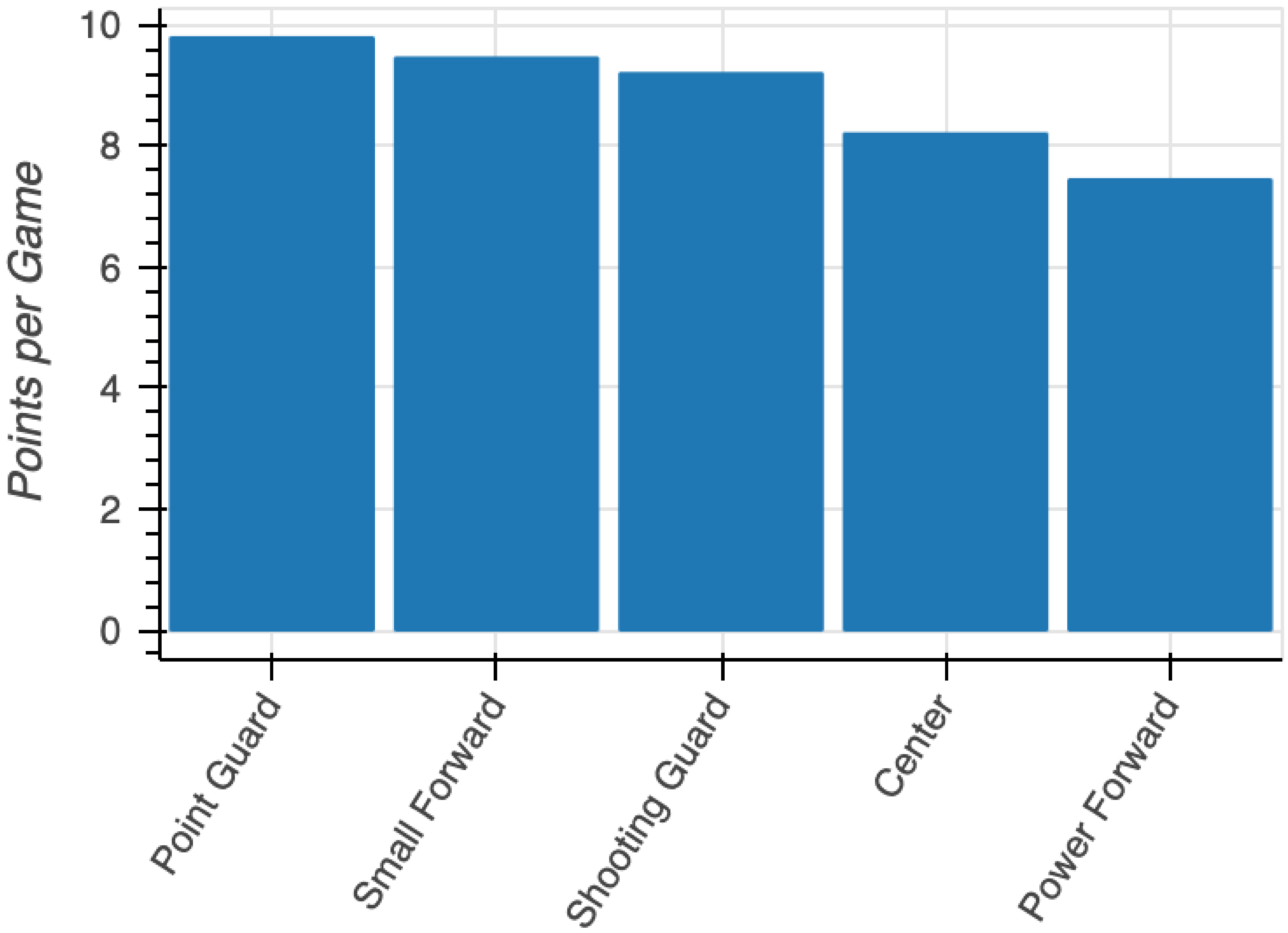
```
fig = figure(x_range=nba["position"],
             x_axis_label="Position",
             y_axis_label="Points per Game")
fig.vbar(x=nba["position"], top=nba["points"],
         width=0.9)
output_file(filename="padded_plot.html")
show(fig)
```



Orientation

```
fig = figure(x_range=nba['position'],
             x_axis_label="Position",
             y_axis_label="Points per Game")
fig.vbar(x=nba["position"], top=nba["points"], width=0.9)
fig.xaxis.major_label_orientation = 45
output_file(filename="rotated_x_label_plot.html")
show(fig)
```

Rotated x-axis labels



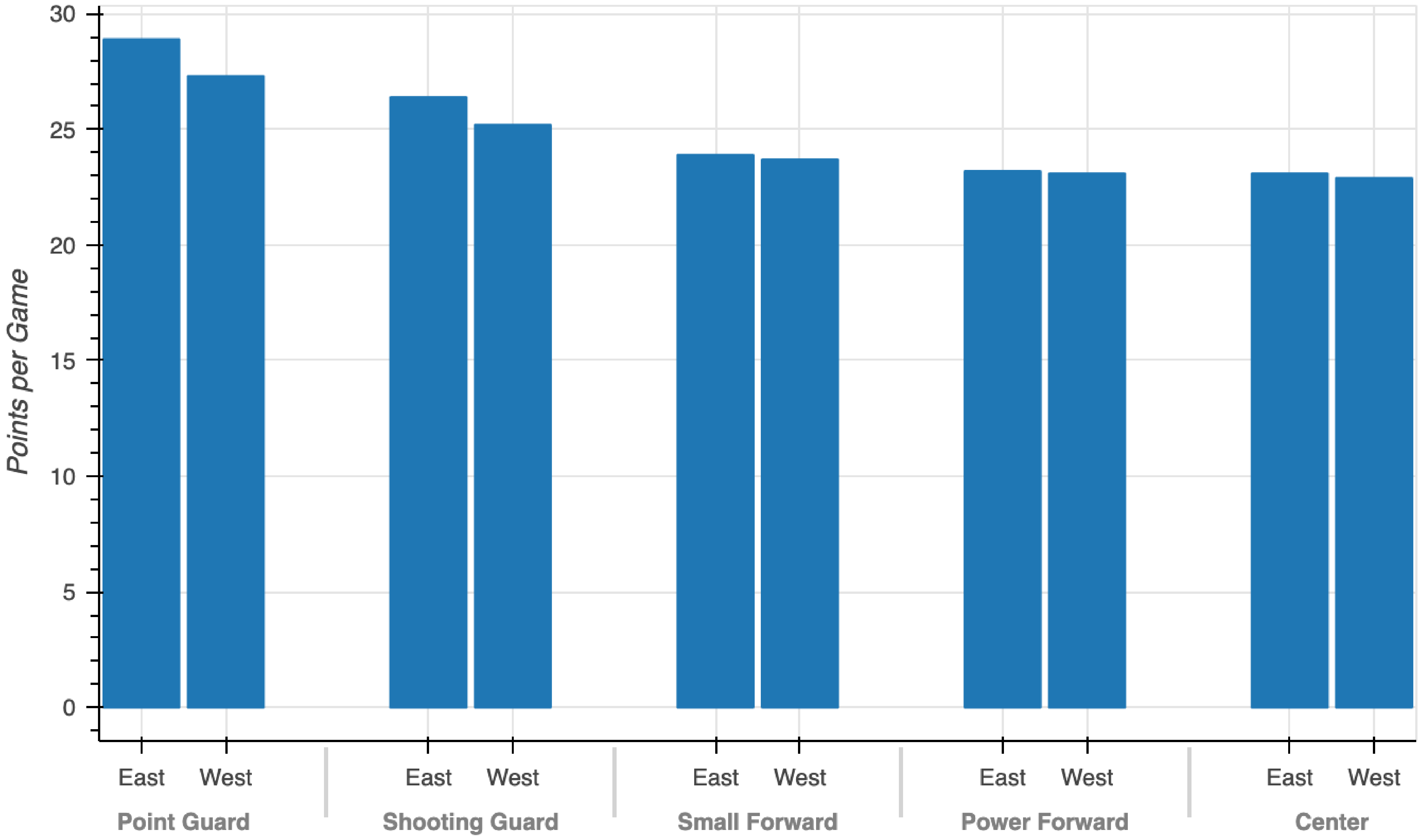
Nested categories

```python
positions = ["Point Guard", "Shooting Guard",
            "Small Forward", "Power Forward", "Center"]
conferences = ["East", "West"]
factors = [("Point Guard", "East"), ("Point Guard", "West"),
           ("Shooting Guard", "East"), ("Shooting Guard", "West"),
           ("Small Forward", "East"), ("Small Forward", "West"),
           ("Power Forward", "East"), ("Power Forward", "West"),
           ("Center", "East"), ("Center", "West")]
```

Building a grouped bar plot

```python
from bokeh.models import FactorRange
fig = figure(x_range=FactorRange(*factors), y_axis_label="Points per Game")
fig.vbar(x=factors, top=nba["points"], width=0.9)
output_file(filename="grouped_bar_plot.html")
show(fig)
```

Grouped bar plot



Let's practice!

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