

# Statistical graphics in ClojureScript

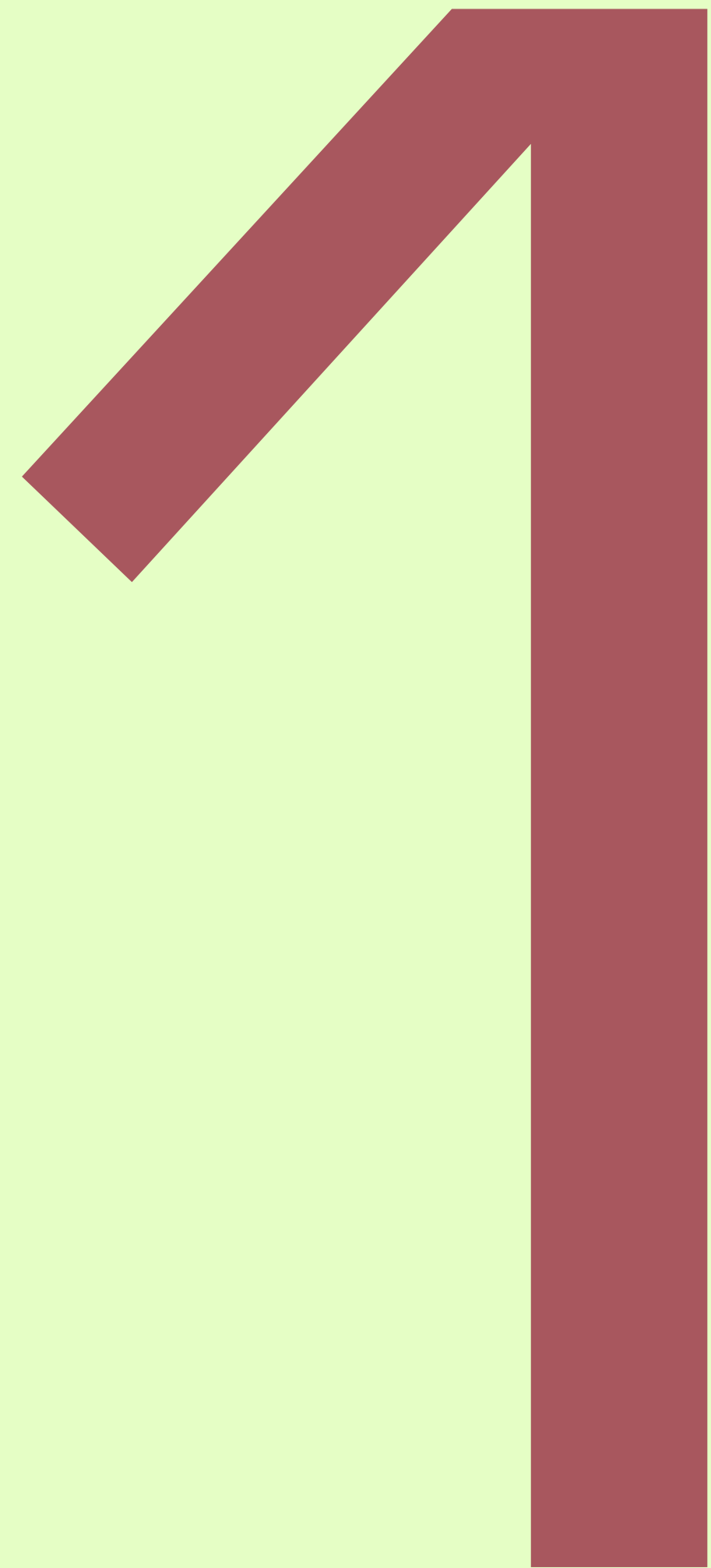
Kevin Lynagh

Keming Labs @lynaghk

2012 July 31

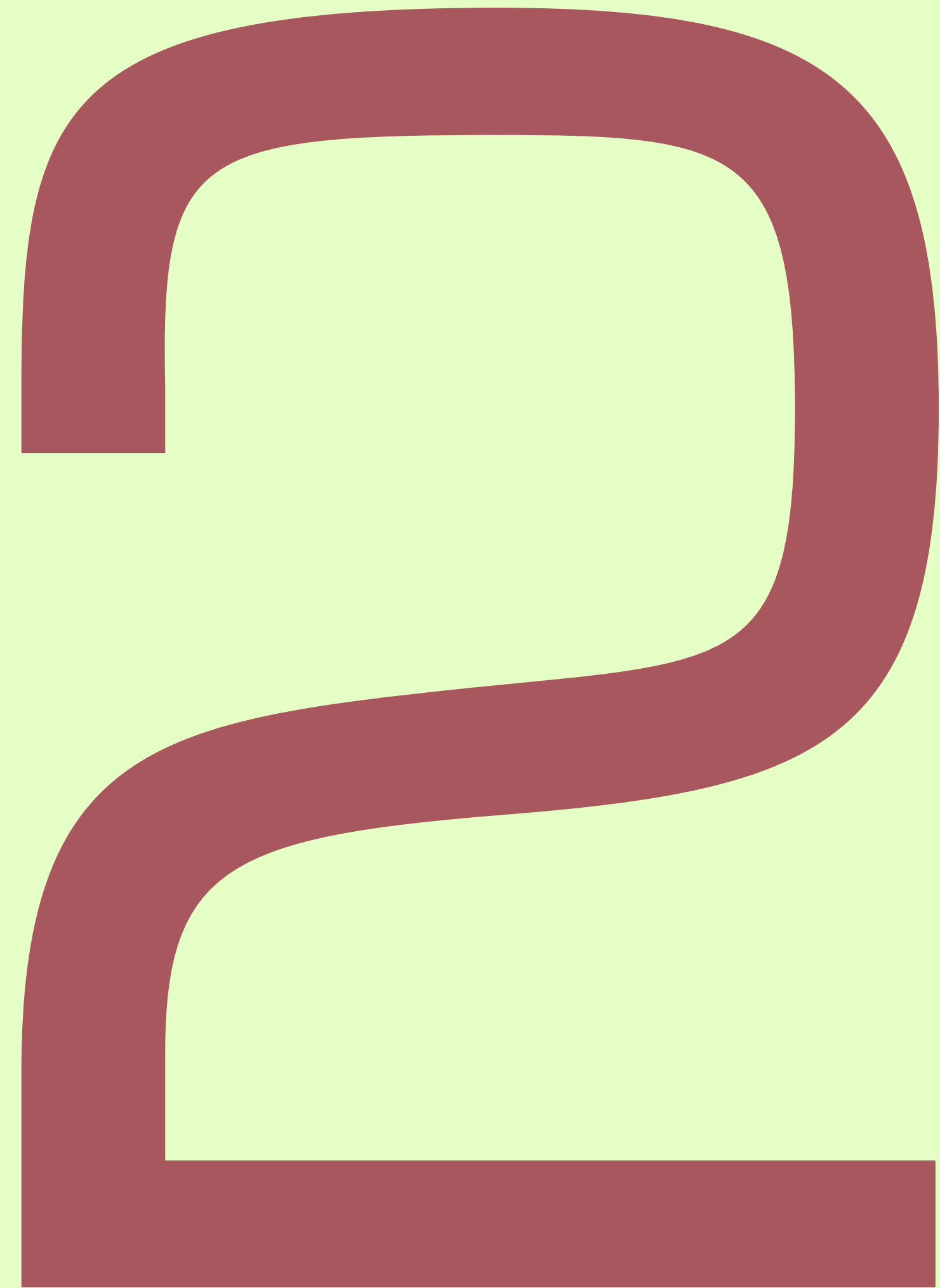
Joint Statistical Meeting

# Agenda



What *is*  
**visualization**





doin' it  
on the  
*Internets*

Agenda

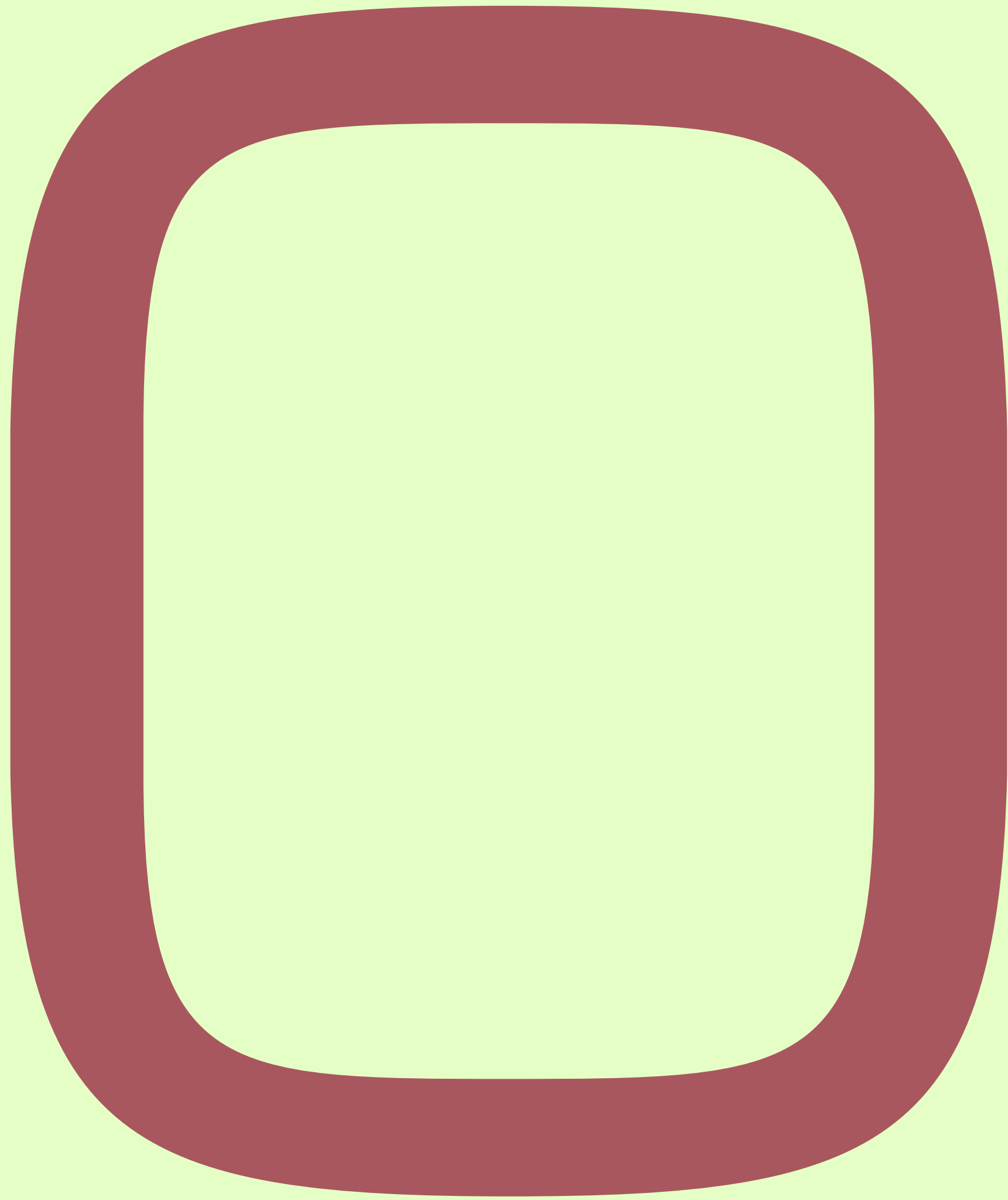
3

an  
*Example*



Bespoke  
vs.  
*Exploratory*

# Anti-Agenda

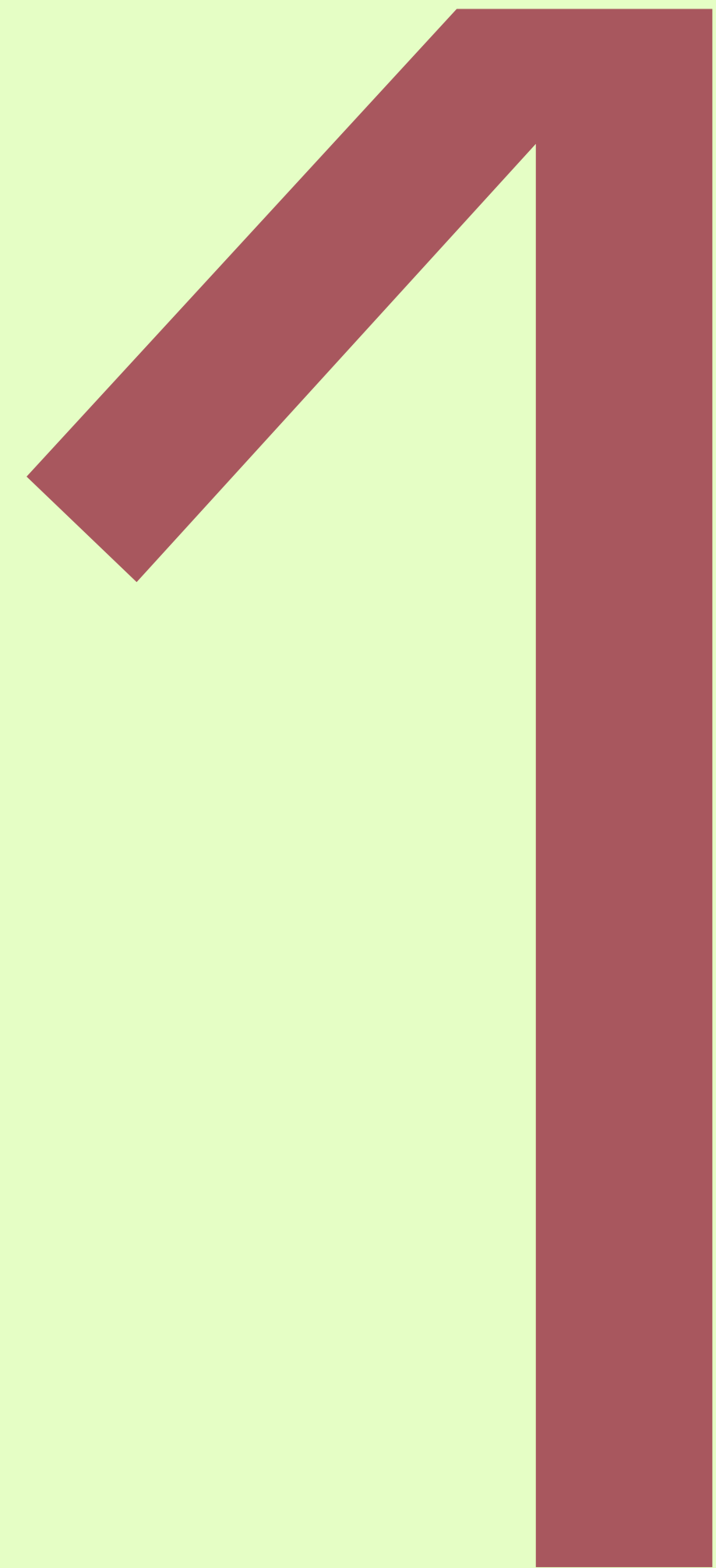


~~Tech~~

**ideas Talk**

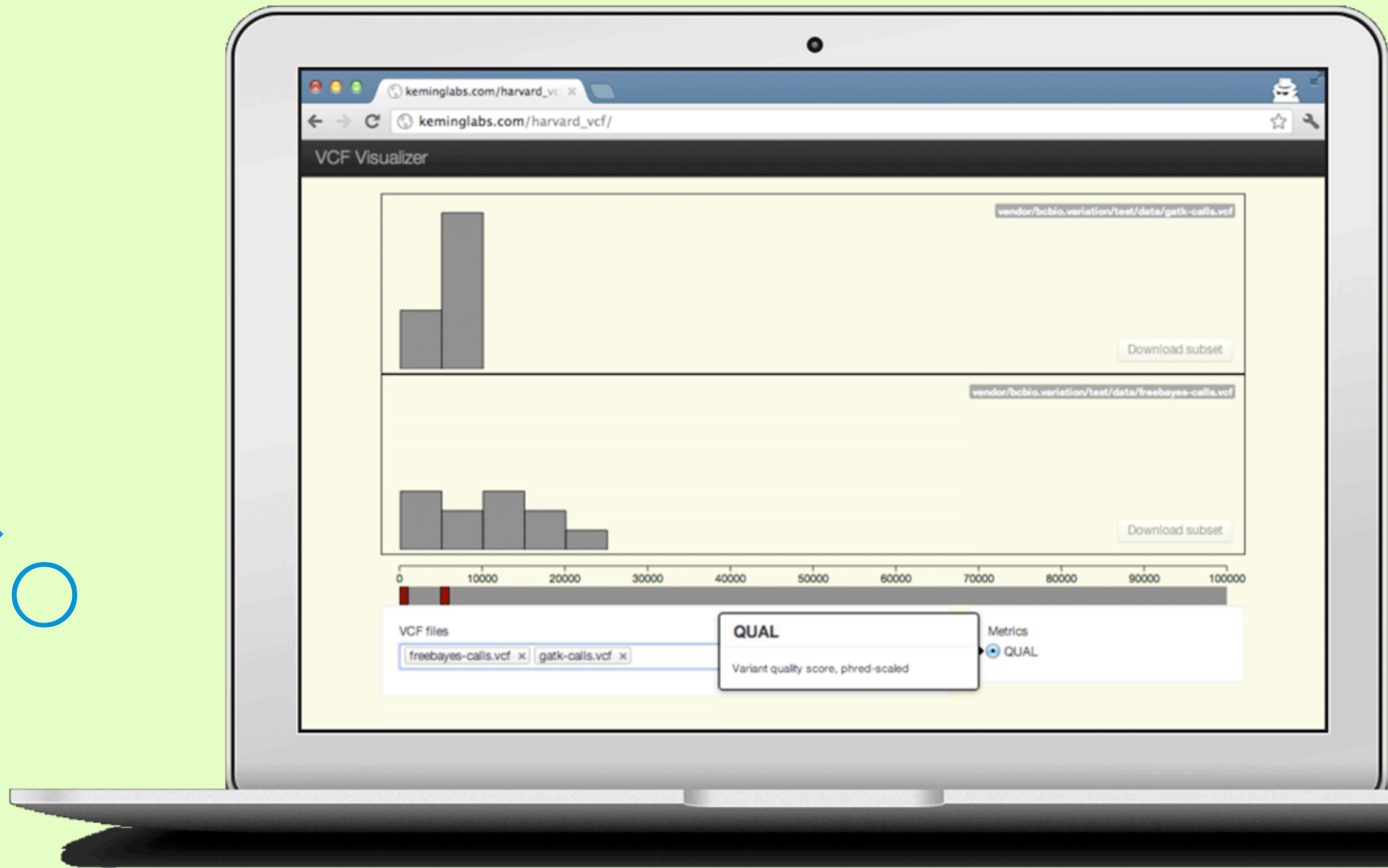




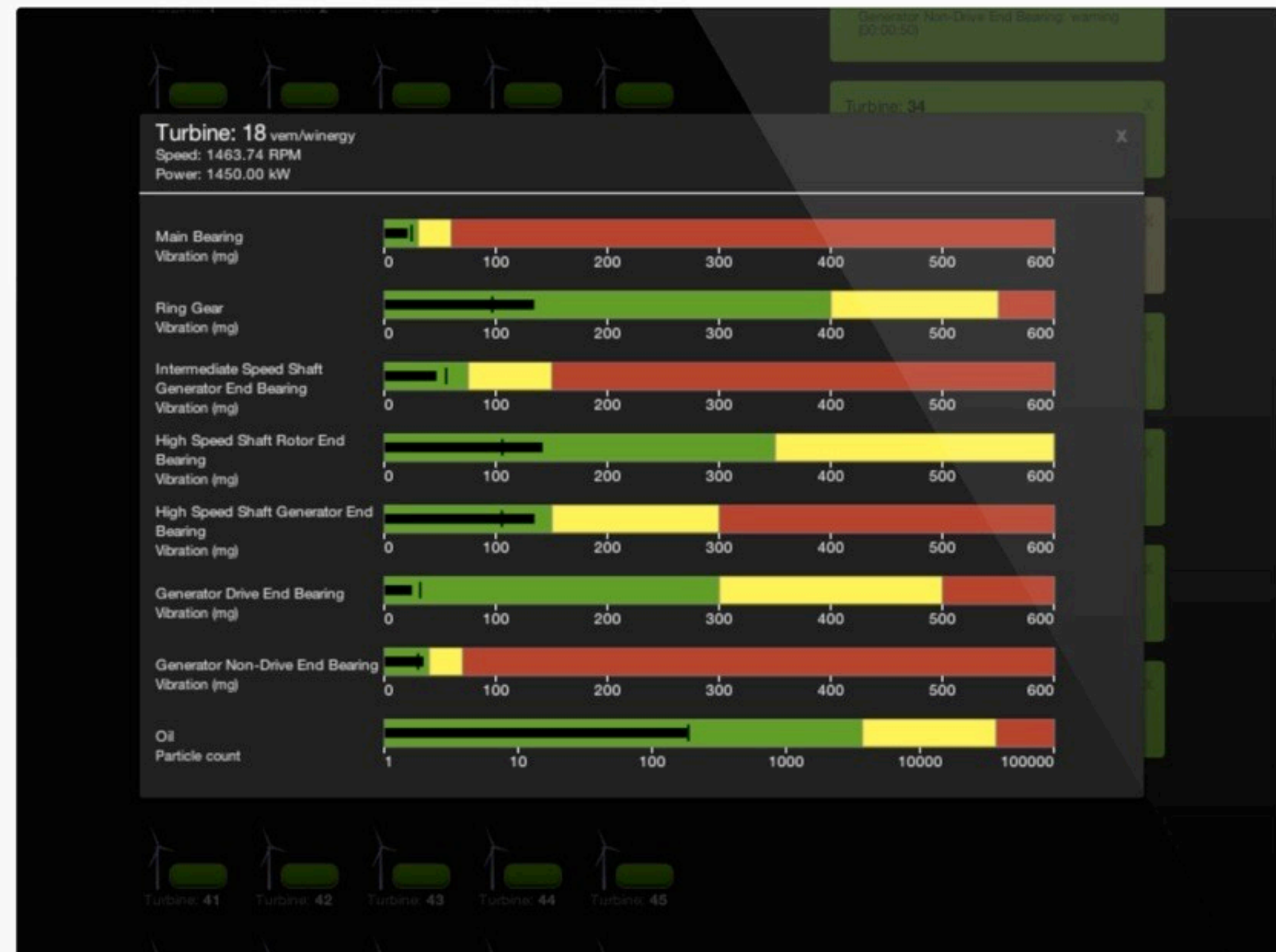


What *is*  
**Visualization**

# Bioinformatics



# Wind energy



Doc & patient,  
meet

Data





ORBITZ **MATRIX** DISPLAY™

My Search

**Need a hotel too?**

Book flight + hotel together for a discount

[Find Flight + Hotel](#)

Find flights by:

Airline

Stops Price

Alaska Airlines	American Airlines	Multiple Carriers	Delta Air Lines

Non-stop

<b>\$257</b> total <a href="#">\$278</a>	<b>\$257</b> total <a href="#">\$278</a>	<b>\$257</b> total <a href="#">\$285</a>	<b>\$287</b> total <a href="#">\$308</a>
---	---	---	---

1 stop

The lowest fare is shown above. Still want more options? [Show all flights](#)

Fares are per person in US dollars, using e-tickets. Total fare includes airfare taxes and fees. Additional baggage charges may apply. Some itineraries require paper tickets with an additional charge. Changes after booking are subject to change fees.

Sort flights by:

**Lowest price**

Departure time

Shortest flight

[Airport codes](#)

Change Search

From City name or [airport](#)

PDX

incl. nearby airports

To City name or [airport](#)

SJC

incl. nearby airports

Leave

03/15/12

Depart ⇅

Anytime ⇅

Showing lowest priced flights (45 flights out of 180 total)

[See all 180 flights](#)

[Select](#) **\$257 + \$21 taxes & fees = \$278 USD** per person **NO BOOKING FEES** **PRICE ASSURANCE**

Leave **Thu, Mar 15** **Alaska Airlines 400**  
 Depart:6:10am Arrive:7:55am  
 Portland, OR (PDX) San Jose, CA (SJC)  
**Non-stop** Economy | 1hr 45min | Boeing 737 | [View seats](#)

[Choose this departure](#)

Return **Sun, Mar 18** **Alaska Airlines 2546**  
 operated by HORIZON AIR DBA ALASKA HORIZON  
 San Jose, CA (SJC) Portland, OR (PDX)

[Choose this return](#)

Sponsored Links

[Fly Portland to San Jose](#)

Enjoy every day low fares on Alaska Air. Book today!  
[www.alaskaair.com](http://www.alaskaair.com)

[Costa Rica from \\$149](#)

Costa Rica Fares Just Dropped! Book Now to Lock In the Best Deals.  
[www.lowfares.com/Costa-Rica-Fares](http://www.lowfares.com/Costa-Rica-Fares)

[San Jose Cheap Deals](#)

Food, Spas & More up to 90% Off. Limited Availability- Act Now!  
[www.groupon.com](http://www.groupon.com)

[Cheapest San Jose Flights](#)

Up to 65% off **San Jose Flights**. No Service Fees on all Flights!  
[www.travelocity.com/San-Jose](http://www.travelocity.com/San-Jose)

Sort By Agony Price Duration Departure Arrival Airlines Non-stops

(didn't make this, just ♥ it)

Price	9am	1pm	5pm	9pm	1am	5am
From \$279						
From \$279						
From \$279						
From \$279						
From \$279						
From \$289						
From \$289						
From \$303						
From \$310						
From \$329			SEA Alaska			
From \$329				SEA Alaska		
From \$329	SEA Alaska					
From \$329		SEA Alaska				
From \$350				United LAX Alaska		
From \$320	Alaska*	LAX				
From \$132			Amtrak			

What

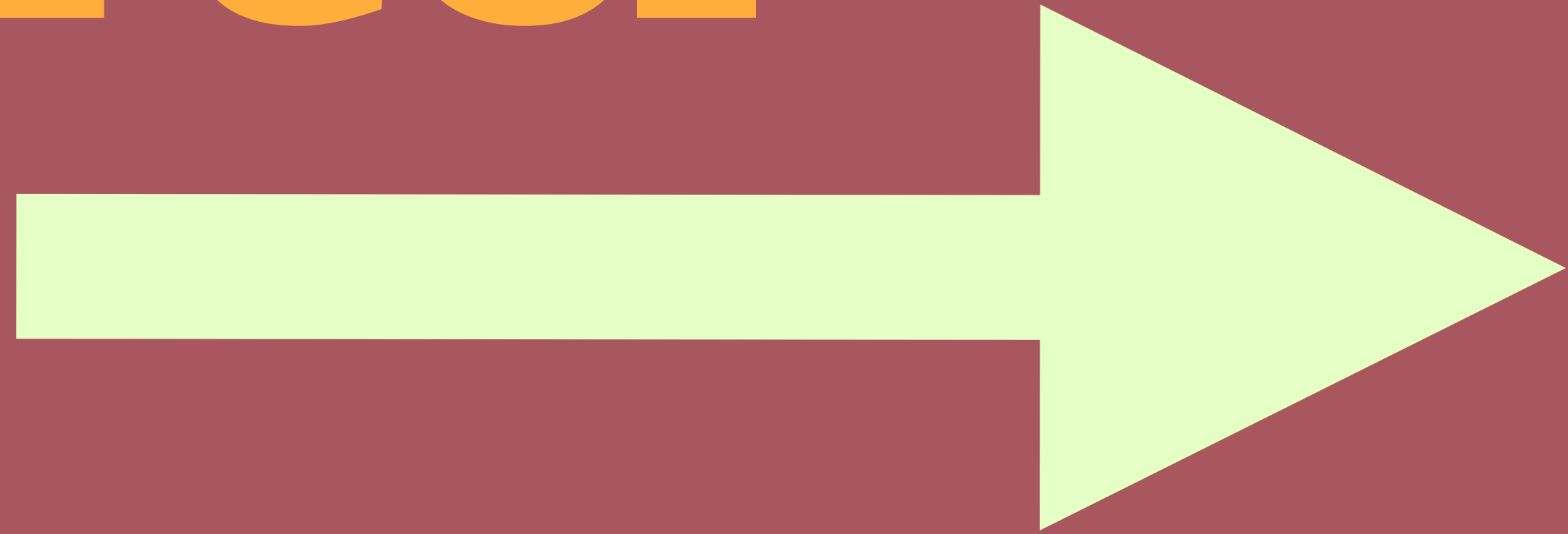
do these things

have in

**common.**



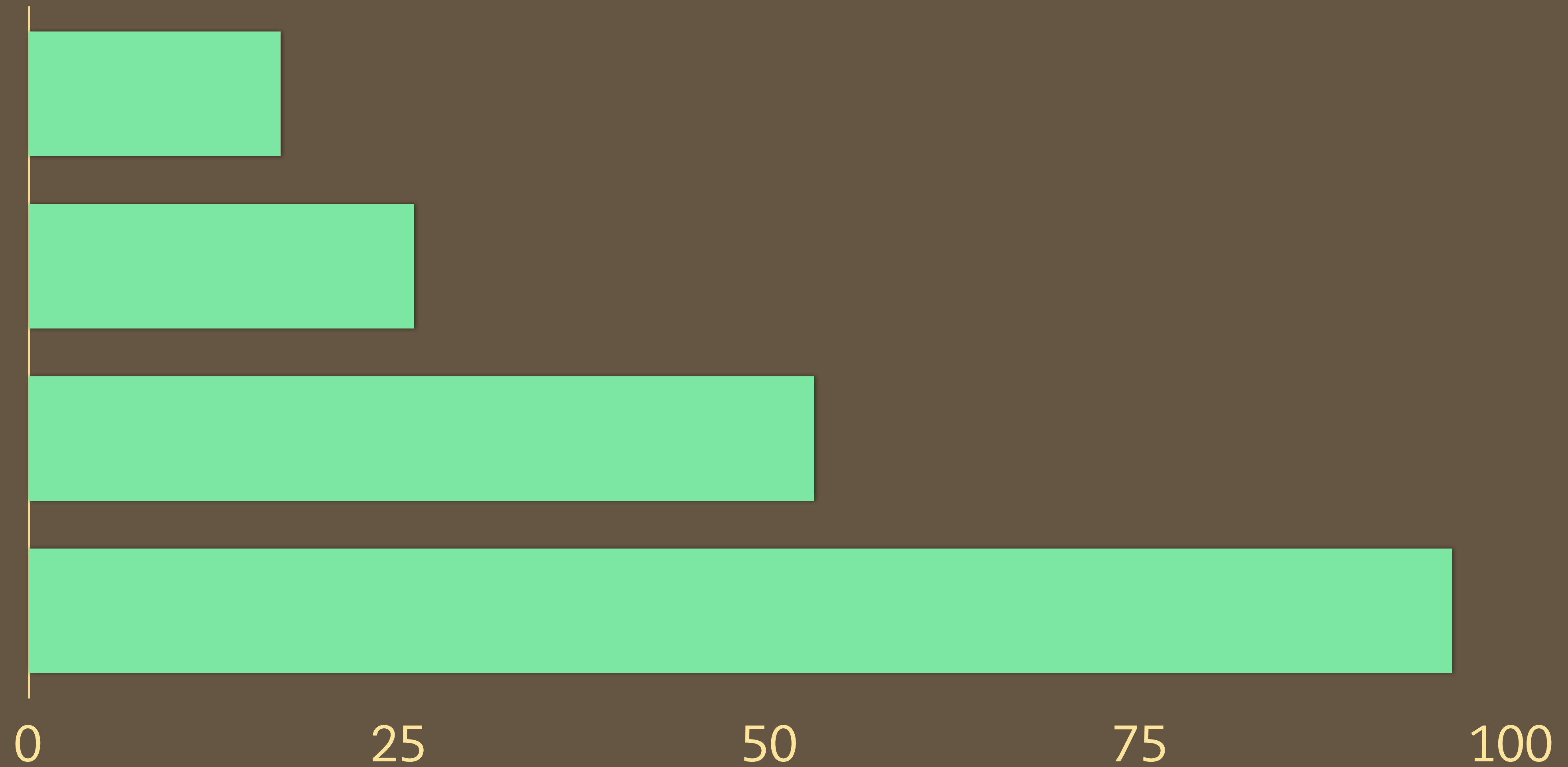
# Data



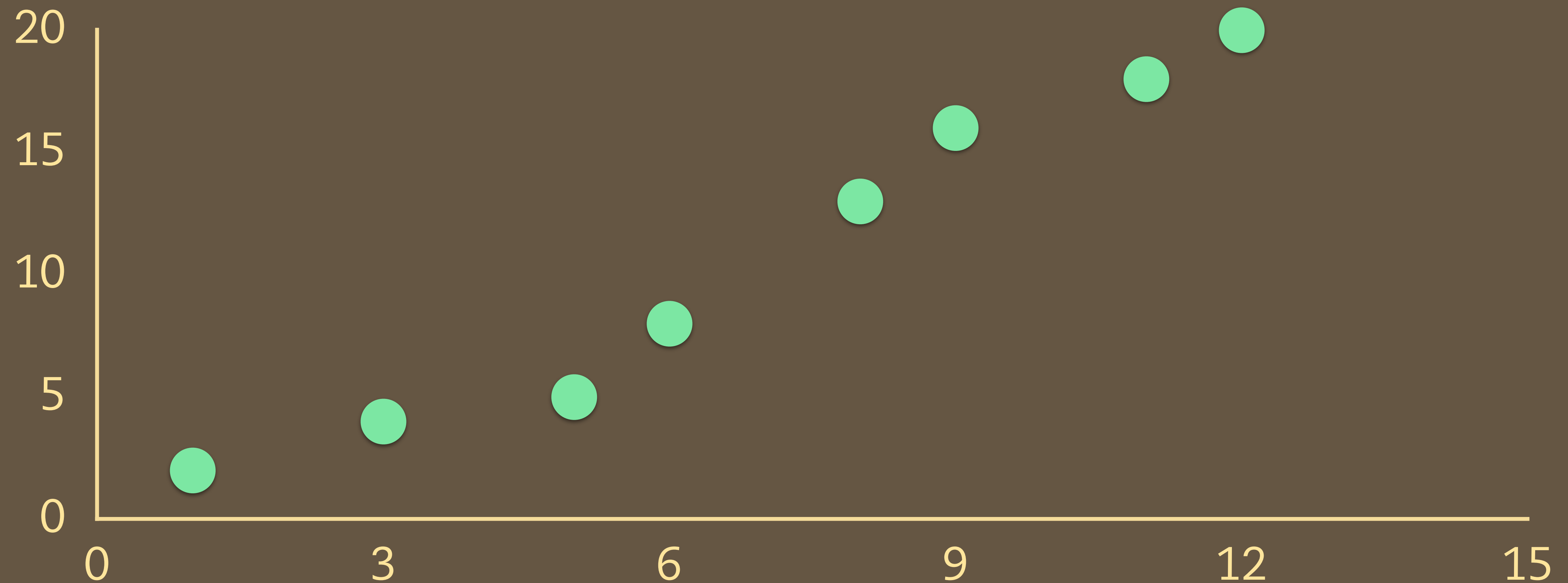
# visual

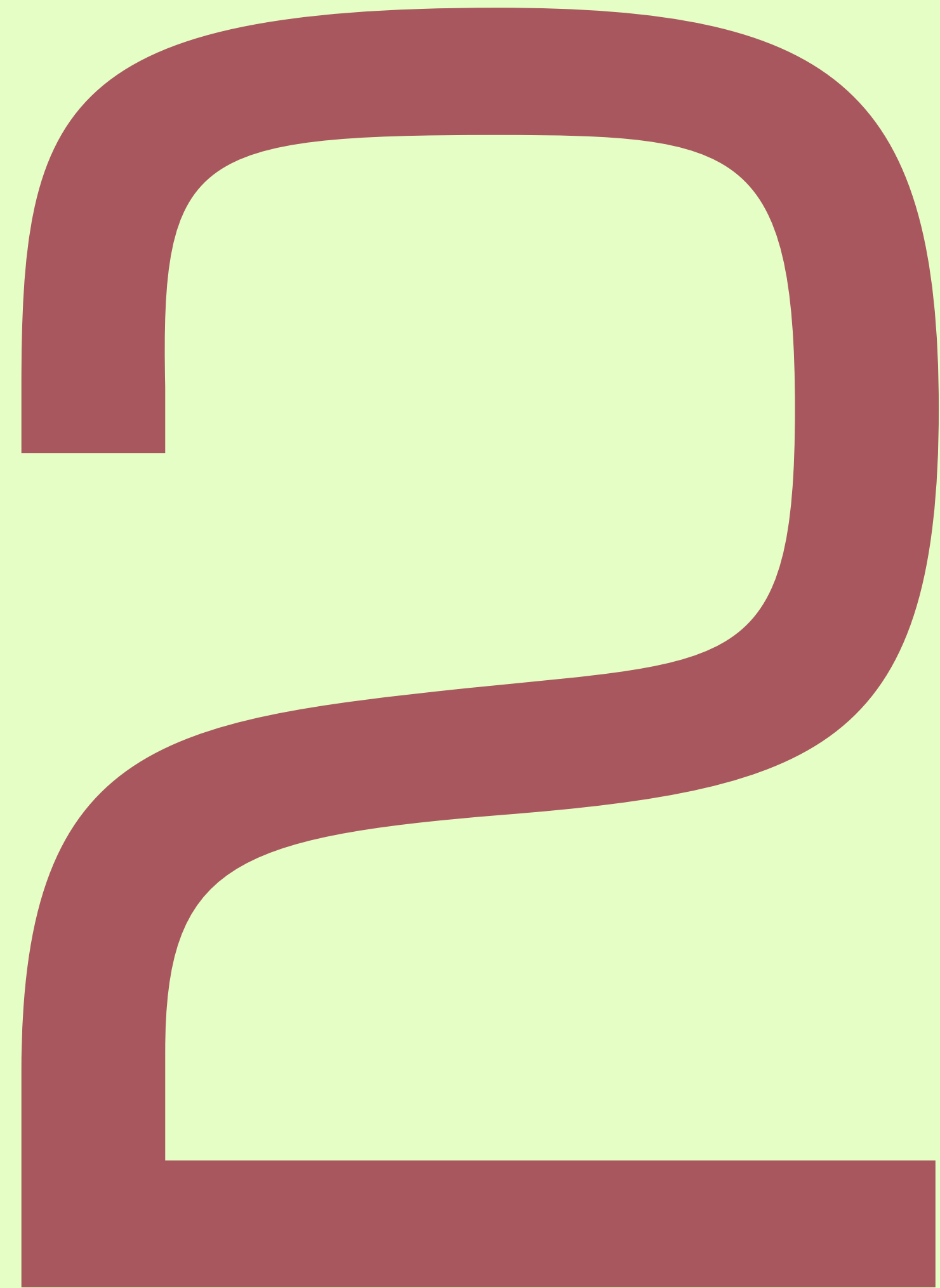


Data: [17, 26, 53, 96]



Data:  $[[1, 2] [3, 4] [5, 5] [6, 8]$   
 $[8, 13] [9, 16] [11, 18]]$

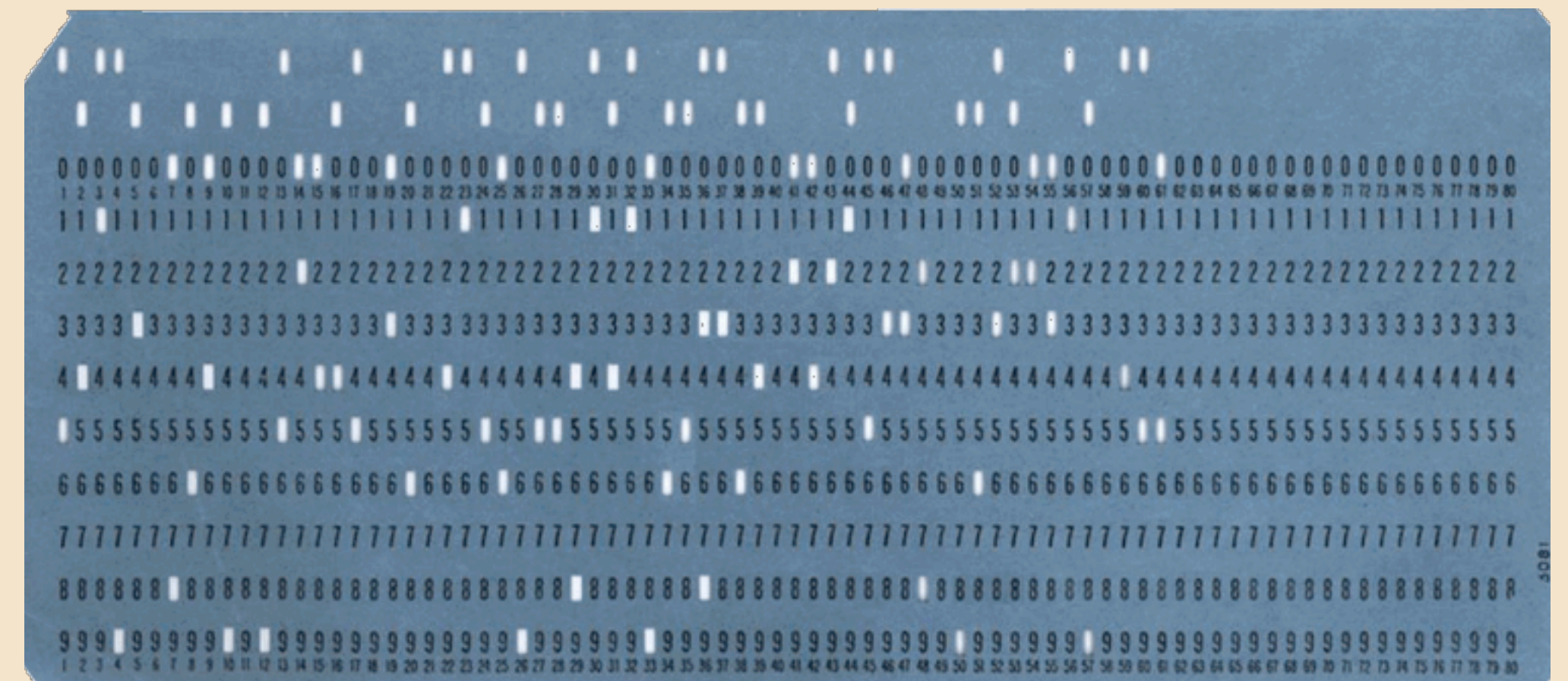
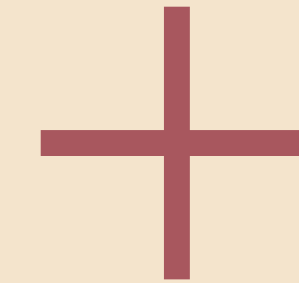
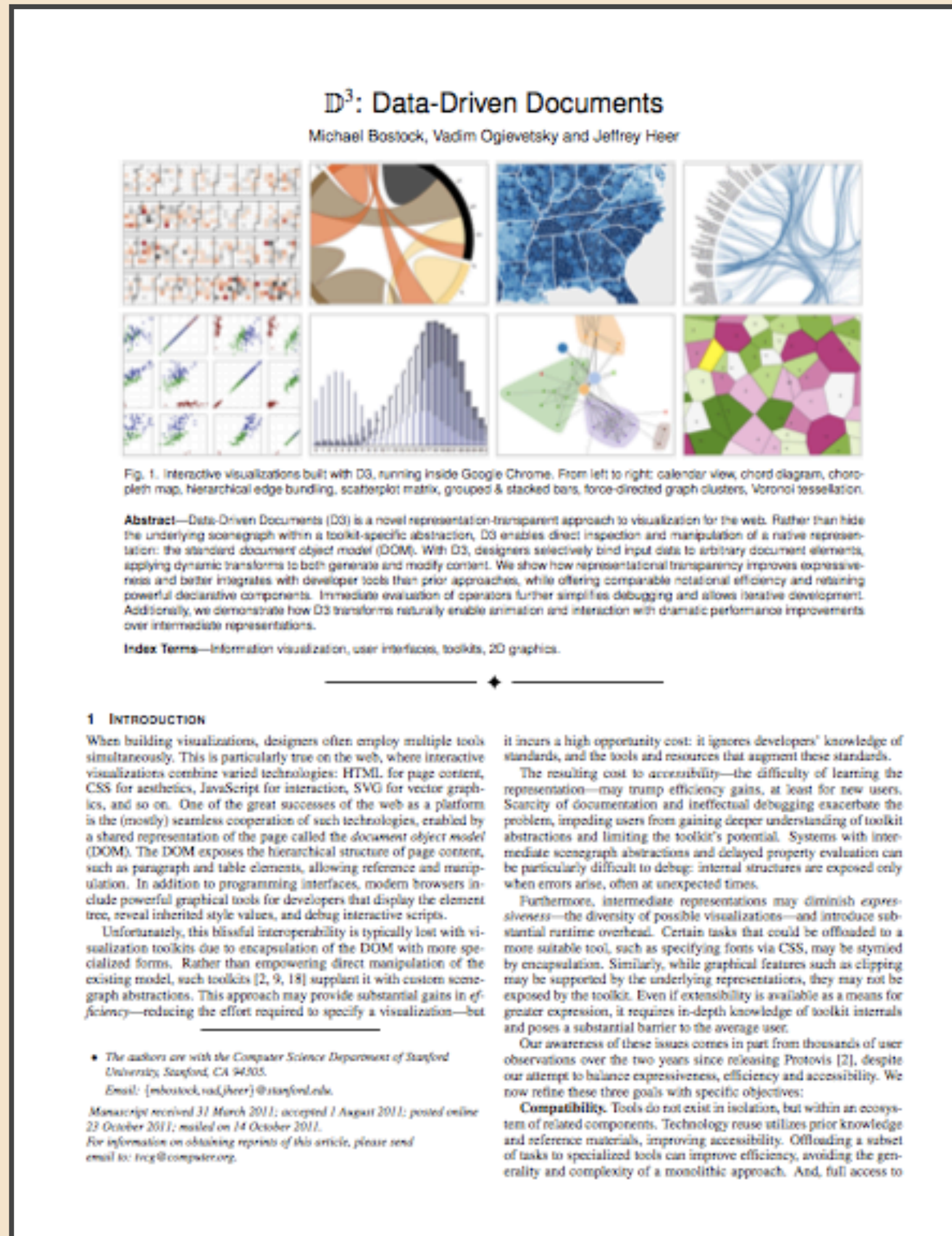




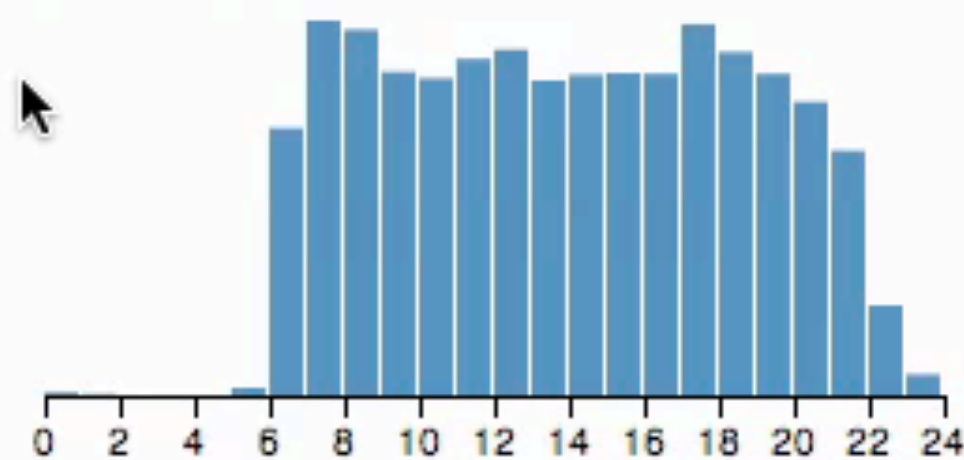
doin' it  
on the  
*Internets*

# D3: Data Driven Documents (2011)

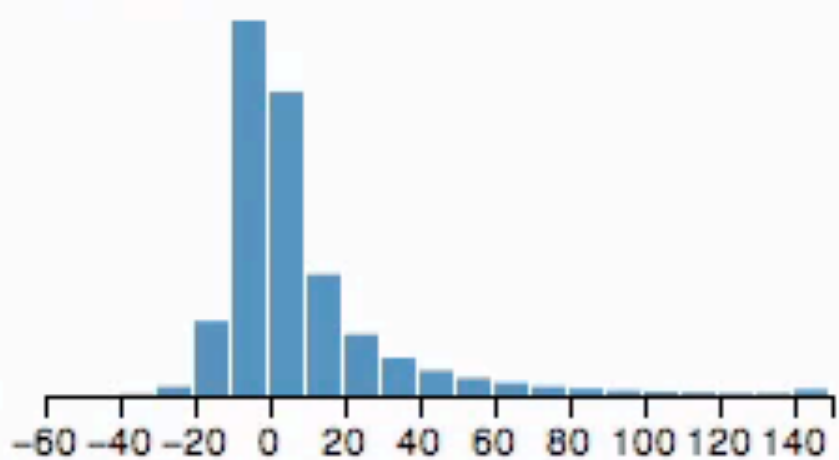
Mike Bostock Jeffrey Heer Vadim Ogievetsky



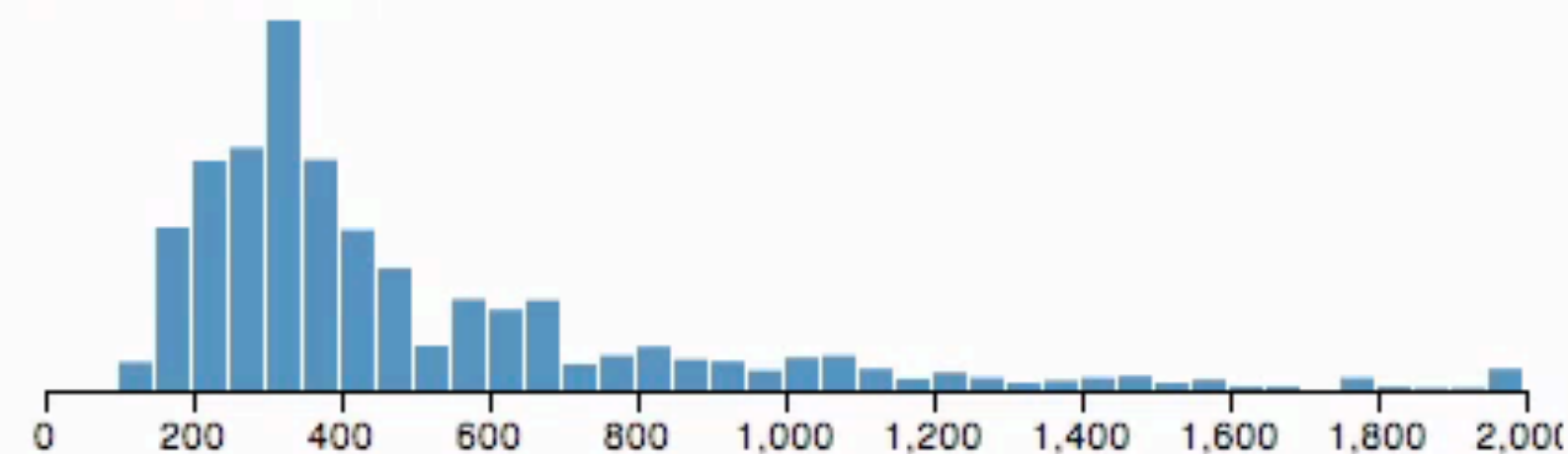
Time of Day



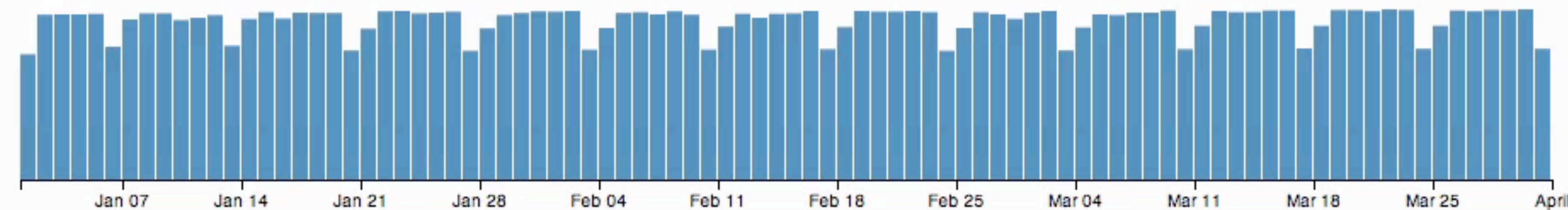
Arrival Delay (min.)



Distance (mi.)



Date



March 31, 2001

231,083 of 231,083 flights selected.

03:33 PM	LAX	OAK	337 mi.	-5 min.
10:48 PM	STL	MCO	880 mi.	+125 min.
10:37 PM	BNA	RDU	443 mi.	+106 min.
10:30 PM	HOU	MSY	303 mi.	-8 min.
10:10 PM	OMA	MDW	423 mi.	-7 min.
10:00 PM	HOU	MSY	303 mi.	-7 min.
09:55 PM	MSY	MCO	550 mi.	-16 min.
09:51 PM	MCO	MSY	550 mi.	+70 min.
09:45 PM	BNA	BWI	588 mi.	-5 min.
09:35 PM	OMA	STL	342 mi.	+153 min.
09:35 PM	CMH	MDW	284 mi.	-7 min.

# Awesome

## • Declarative

Easy to think, explore  
Optimizable

## • Familiar representation

HTML, CSS, SVG; dev tools  
No reinvented wheels

# Awesomer

## • Clojure(Script)

Rich data structures

Namespaces

Deliberate state/mutation



Agenda

3

an  
*Example*





ORBITZ **MATRIX** DISPLAY™

My Search

**Need a hotel too?**

Book flight + hotel together for a discount

[Find Flight + Hotel](#)

Find flights by:

Airline

Stops Price

Alaska Airlines	American Airlines	Multiple Carriers	Delta Air Lines

Non-stop

<b>\$257</b> total <a href="#">\$278</a>	<b>\$257</b> total <a href="#">\$278</a>	<b>\$257</b> total <a href="#">\$285</a>	<b>\$287</b> total <a href="#">\$308</a>
---	---	---	---

1 stop

The lowest fare is shown above. Still want more options? [Show all flights](#)

Fares are per person in US dollars, using e-tickets. Total fare includes airfare taxes and fees. Additional baggage charges may apply. Some itineraries require paper tickets with an additional charge. Changes after booking are subject to change fees.

Sort flights by:

**Lowest price**

Departure time

Shortest flight

[Airport codes](#)

Change Search

From City name or [airport](#)

PDX

incl. nearby airports

To City name or [airport](#)

SJC

incl. nearby airports

Leave

03/15/12

Depart ⇅

Anytime ⇅

Showing lowest priced flights (45 flights out of 180 total)

[See all 180 flights](#)

[Select](#) **\$257 + \$21 taxes & fees = \$278 USD** per person **NO BOOKING FEES** **PRICE ASSURANCE** <sup>i</sup>

Leave **Thu, Mar 15** **Alaska Airlines 400**  
 Depart: 6:10am Arrive: 7:55am  
 Portland, OR (PDX) San Jose, CA (SJC)  
**Non-stop** Economy | 1hr 45min | Boeing 737 | [View seats](#)

[Choose this departure](#)

Return **Sun, Mar 18** **Alaska Airlines 2546**  
 operated by HORIZON AIR DBA ALASKA HORIZON  
 San Jose, CA (SJC) Portland, OR (PDX)

[Choose this return](#)

Sponsored Links

[Fly Portland to San Jose](#)

Enjoy every day low fares on Alaska Air. Book today!  
[www.alaskaair.com](http://www.alaskaair.com)

[Costa Rica from \\$149](#)

Costa Rica Fares Just Dropped! Book Now to Lock In the Best Deals.  
[www.lowfares.com/Costa-Rica-Fares](http://www.lowfares.com/Costa-Rica-Fares)

[San Jose Cheap Deals](#)

Food, Spas & More up to 90% Off. Limited Availability- Act Now!  
[www.groupon.com](http://www.groupon.com)

[Cheapest San Jose Flights](#)

Up to 65% off **San Jose Flights**. No Service Fees on all Flights!  
[www.travelocity.com/San-Jose](http://www.travelocity.com/San-Jose)

1 PDX → SJC on Thu, Mar 15

2 SJC → PDX on Sun, Mar 18

Sort By **Agony** Price Duration Departure Arrival Airlines Non-stops

	9am	1pm	5pm	9pm	1am	5am
From \$279			Alaska			
From \$279	Alaska					
From \$279		Alaska				
From \$279				Alaska		
From \$279		Alaska				
From \$289		SEA	Alaska			
From \$289			Alaska*	LAX		
From \$303				Alaska*	LAX	
From \$310			United	LAX	United	
From \$329			SEA	Alaska		
From \$329				SEA	Alaska	
From \$329	SEA	Alaska				
From \$329		SEA	Alaska			
From \$350				United	LAX	Alaska
From \$320		Alaska*	LAX			
From \$132			Amtrak			

# Start with your data

```
[ { :flight-no 2, :price 106, :carrier "Alaska"  
  :depart 16.91, :arrive 21.42}  
  
  { :flight-no 1, :price 190, :carrier "United"  
    :depart 6.20, :arrive 10.87}  
  
  { :flight-no 5, :price 213, :carrier "United"  
    :depart 4.73, :arrive 9.48}  
    ... ]
```

1 PDX → SJC on Thu, Mar 15

2 SJC → PDX on Sun, Mar 18

Sort By

Agony

Price

Duration

Departure

Arrival

Airlines ▼

Non-stops

9am

1pm

5pm

9pm

1am

5am

From \$279

Alaska

From \$279

Alaska

From \$279

Alaska

From \$279

Alaska

From \$279

Alaska

From \$289

SEA

Alaska

From \$289

Alaska\*

LAX

From \$303

Alaska\*

LAX

From \$310

United

LAX

United

From \$329

SEA

Alaska

From \$329

SEA

Alaska

From \$329

SEA

Alaska

From \$329

SEA

Alaska

From \$350

United

LAX

Alaska

From \$320

Alaska\*

LAX

From \$132

Amtrak

[ :div.row

]

	9am	1pm	5pm	9pm	1am	5am
From \$279			Alaska			
From \$279	Alaska					
From \$279		Alaska				
From \$279				Alaska		
From \$279		Alaska				
From \$289	SEA	Alaska				
From \$289		Alaska*	LAX			
From \$303				Alaska*	LAX	
From \$310			United	LAX	United	

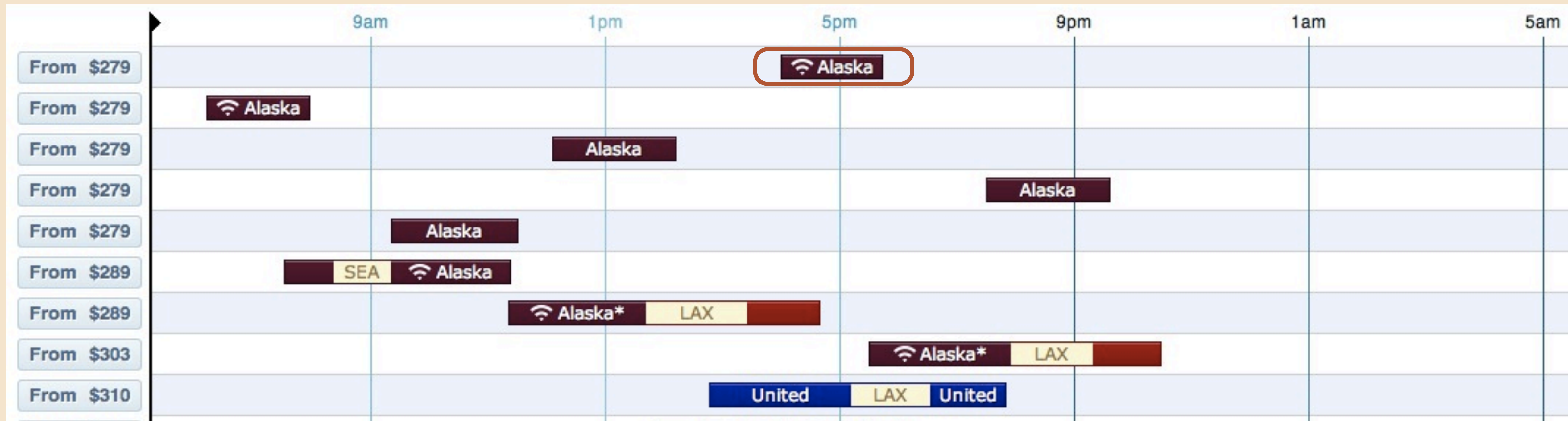
```
[ :div.row  
  [ :button.price (str "$" price) ]  
  
]
```

	9am	1pm	5pm	9pm	1am	5am
From \$279			Alaska			
From \$279	Alaska					
From \$279		Alaska				
From \$279				Alaska		
From \$279		Alaska				
From \$289	SEA	Alaska				
From \$289		Alaska*	LAX			
From \$303				Alaska*	LAX	
From \$310			United	LAX	United	

```

[ :div.row
  [ :button.price (str "$" price) ]
  [ :div.flight
    ] ]

```



```

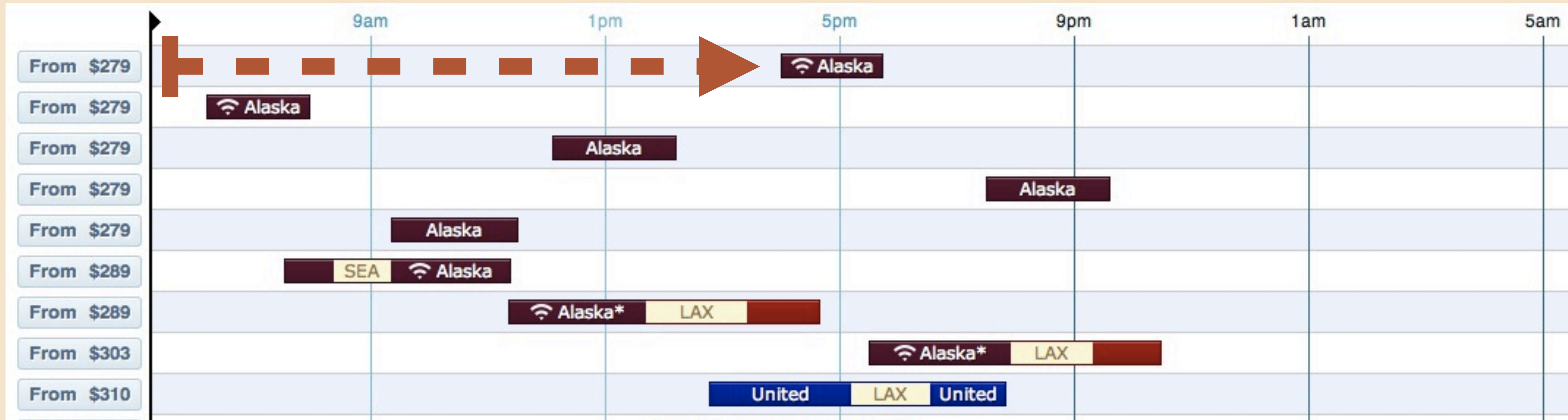
(let [time-scale (scale/linear :domain [0 24]
                               :range :percent)]

  (time-scale 0) ;=> "0%"
  (time-scale 12) ;=> "50%"
  (time-scale 24) ;=> "100%"

)

```

]]

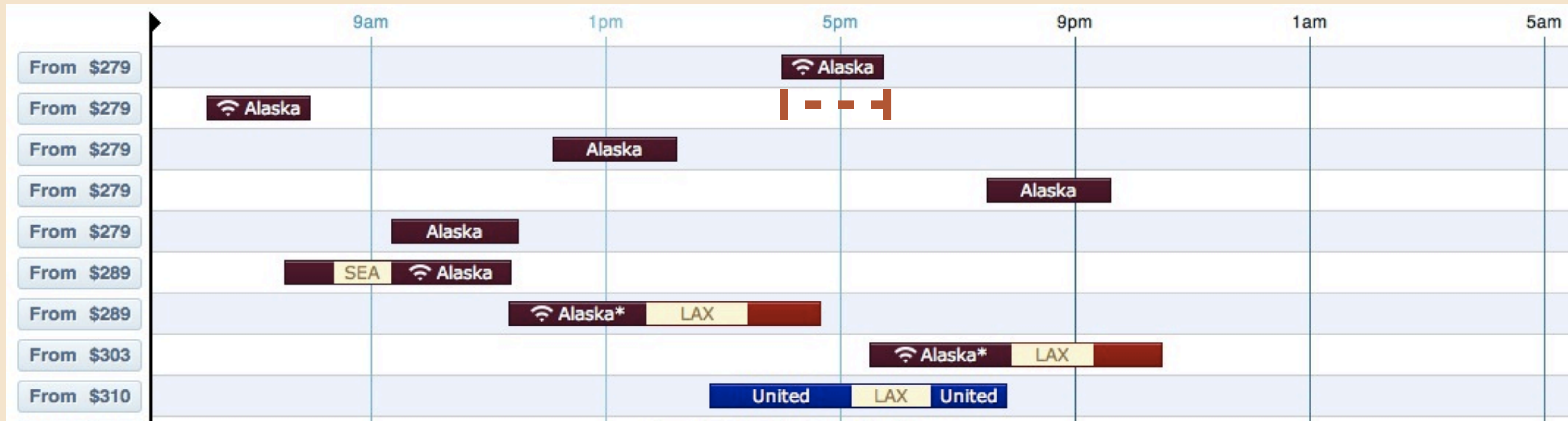




```

[:div.row
  [:button.price (str "$" price)]
  [:div.flight
    {:style {:left (time-scale depart)
              :width (time-scale (- arrive depart))}}
  ]
]]

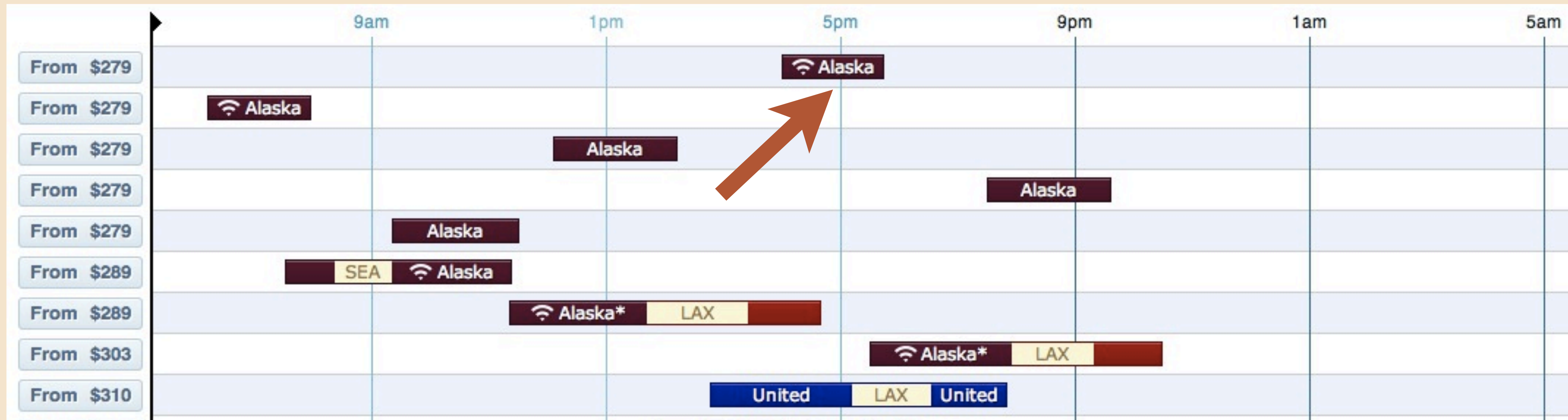
```



```

[:div.row
  [:button.price (str "$" price)]
  [:div.flight
    {:style {:left (time-scale depart)
              :width (time-scale (- arrive depart))}
      [:span carrier]]]

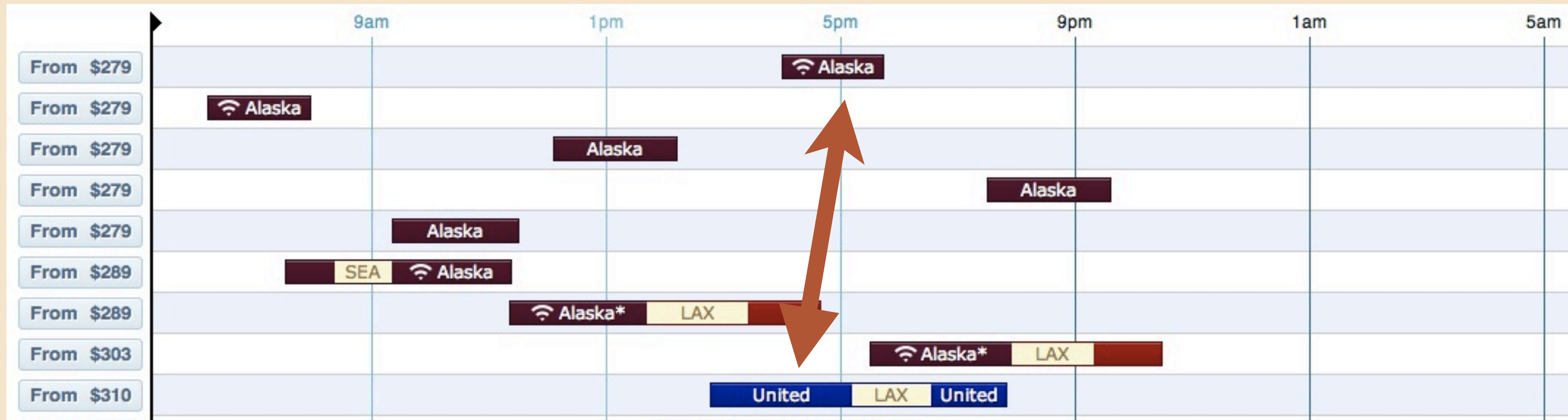
```



```

[:div.row
  [:button.price (str "$" price)]
  [:div.flight
    {:style {:left (time-scale depart)
              :width (time-scale (- arrive depart))}
      :carrier carrier}
    [:span carrier]]]

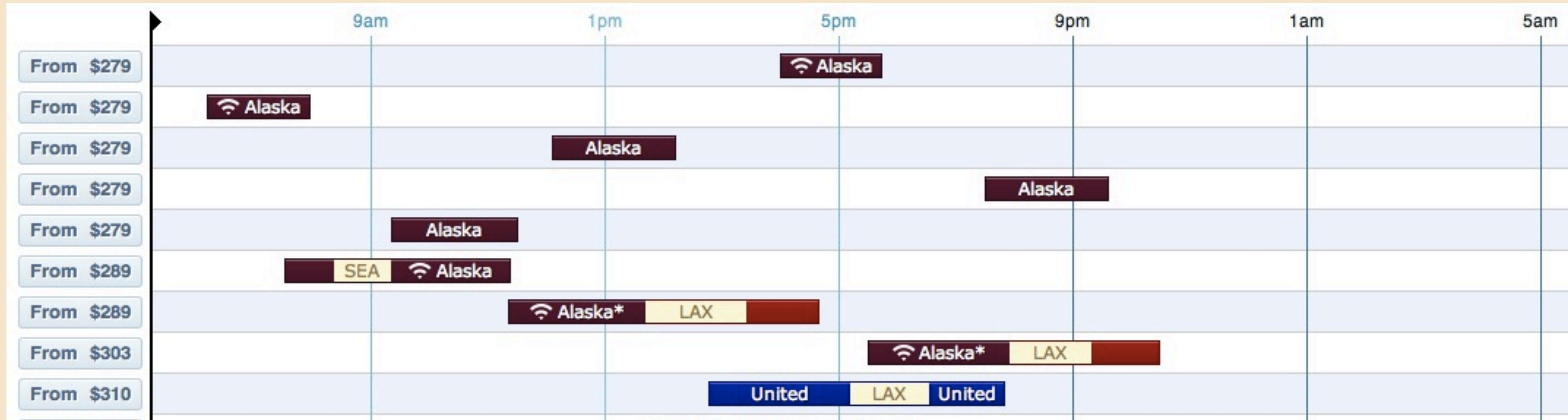
```



```

(fn [{:keys [price carrier depart arrive]}]
  [:div.row
    [:button.price (str "$" price)]
    [:div.flight
      {:style {:left (time-scale depart)
              :width (time-scale (- arrive depart))}
       :carrier carrier}
      [:span carrier]])])

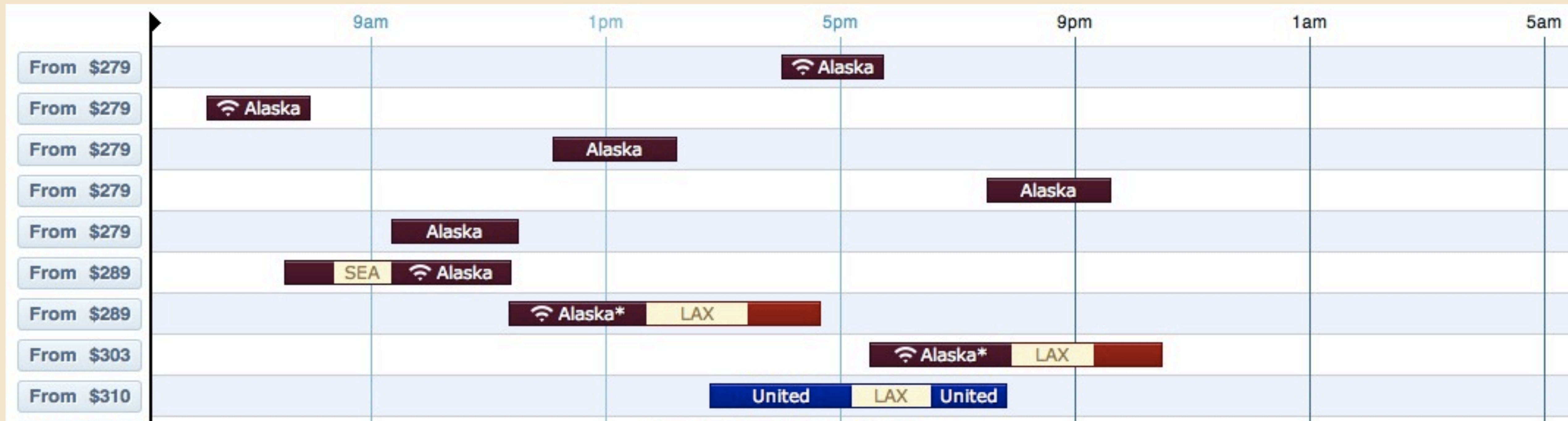
```



```

(map flight-data
  (fn [{:keys [price carrier depart arrive]}]
    [:div.row
      [:button.price (str "$" price)]
      [:div.flight
        {:style {:left (time-scale depart)
                  :width (time-scale (- arrive depart))}
         :carrier carrier}
        [:span carrier]]]))

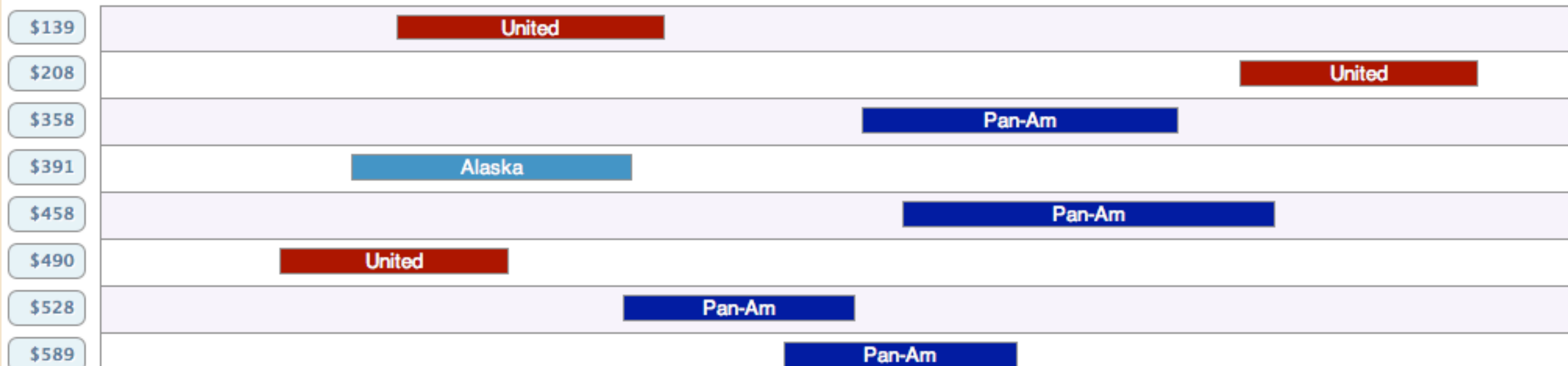
```



```

(map flight-data
  (fn [{:keys [price carrier depart arrive]}]
    [:div.row
      [:button.price (str "$" price)]
      [:div.flight
        {:style {:left (time-scale depart)
                  :width (time-scale (- arrive depart))}
         :carrier carrier}
       [:span carrier]]]))

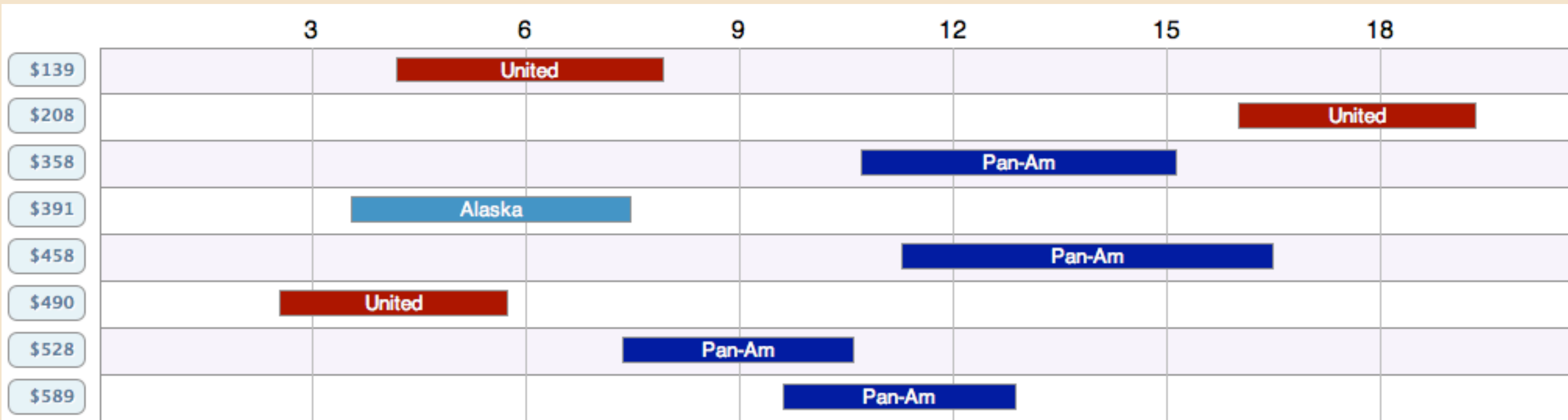
```



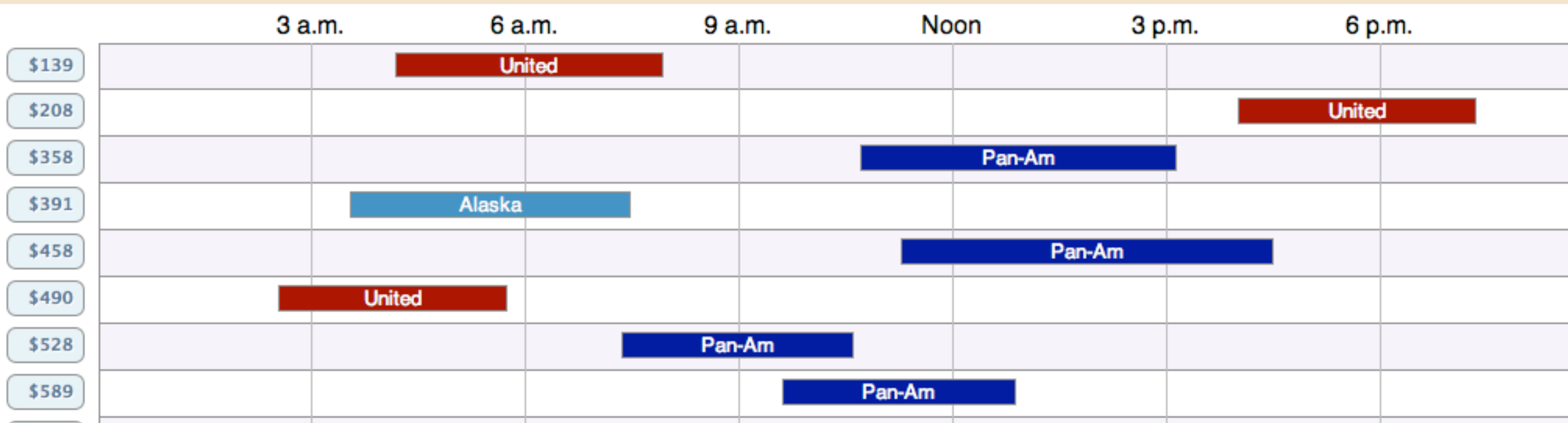
```

(map [3 6 9 12 15 18]
 (fn [t]
  [:div.tick {:style {:left (time-scale t)}}]
  [:div.grid-line]
  [:span.label (str t)])))

```



```
(map [[3 "3 a.m."] [6 "6 a.m."] [9 "9 a.m."]
      [12 "Noon"] [15 "3 p.m."] [18 "6 p.m."]]
  (fn [[t label]]
    [:div.tick {:style {:left (time-scale t)}}]
    [:div.grid-line]
    [:span.label label])))
```





```

(map [ :price :depart :arrive :carrier]
  (fn [field idx] [:button (name field)]))
#flights .flight {
  z-index: 2;
(event/on "#buttons" :click
  -webkit-transition: all 1s ease-out; }
(fn [field] (swap! flight-data #(sort-by field %))))

```



localhost:4000

price depart arrive carrier

	3 a.m.	6 a.m.	9 a.m.	Noon	3 p.m.	6 p.m.
\$139		United				
\$208					United	
\$358				Pan-Am		
\$391	Alaska					
\$458				Pan-Am		
\$490	United					
\$528			Pan-Am			
\$589			Pan-Am			

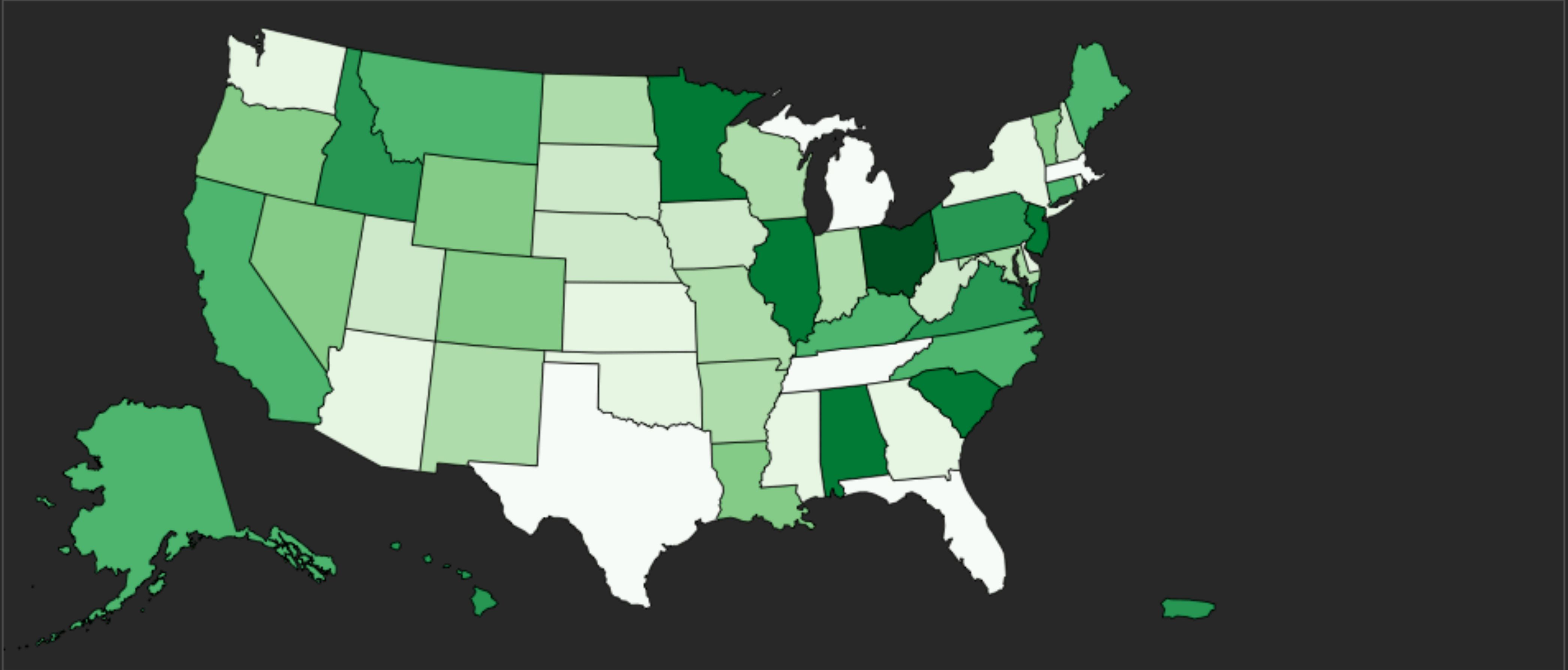
# C2



<http://keminglabs.com/c2>

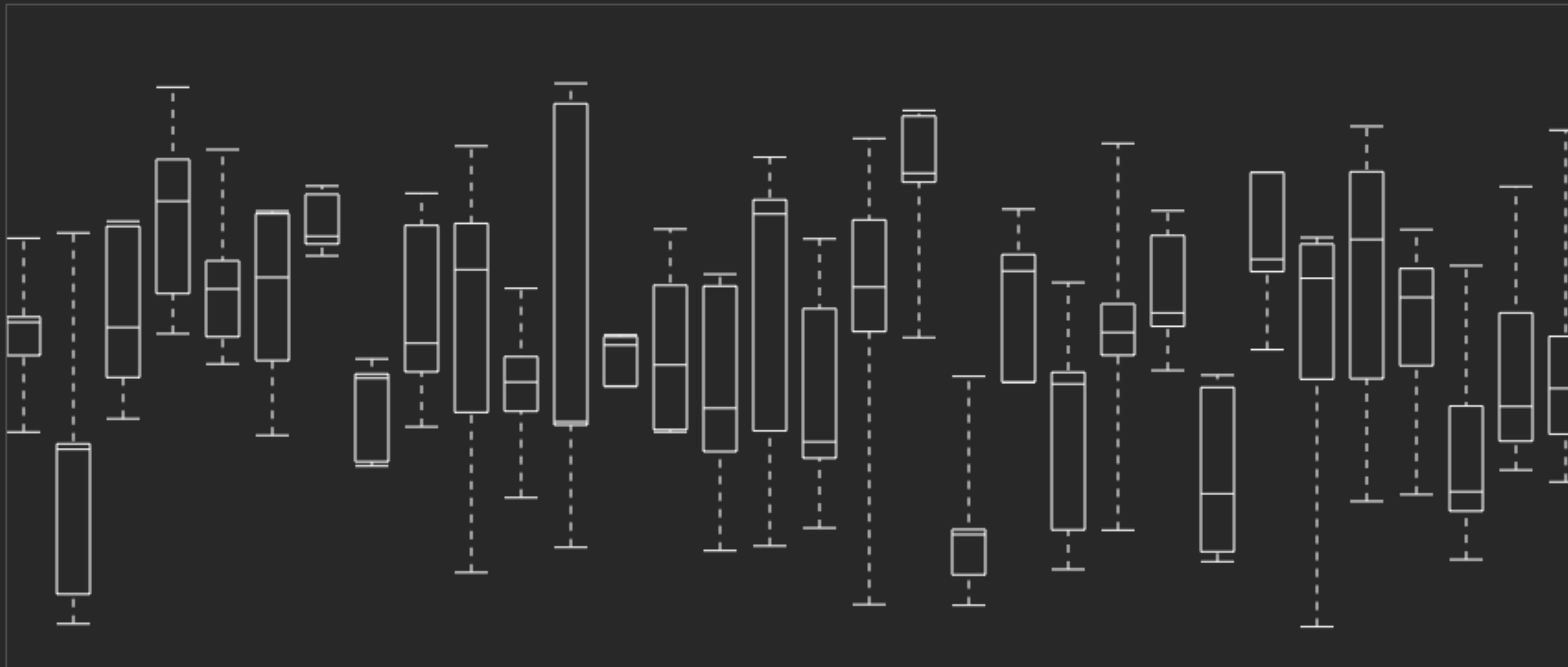
<http://github.com/lynaghk/c2>

# Choropleth



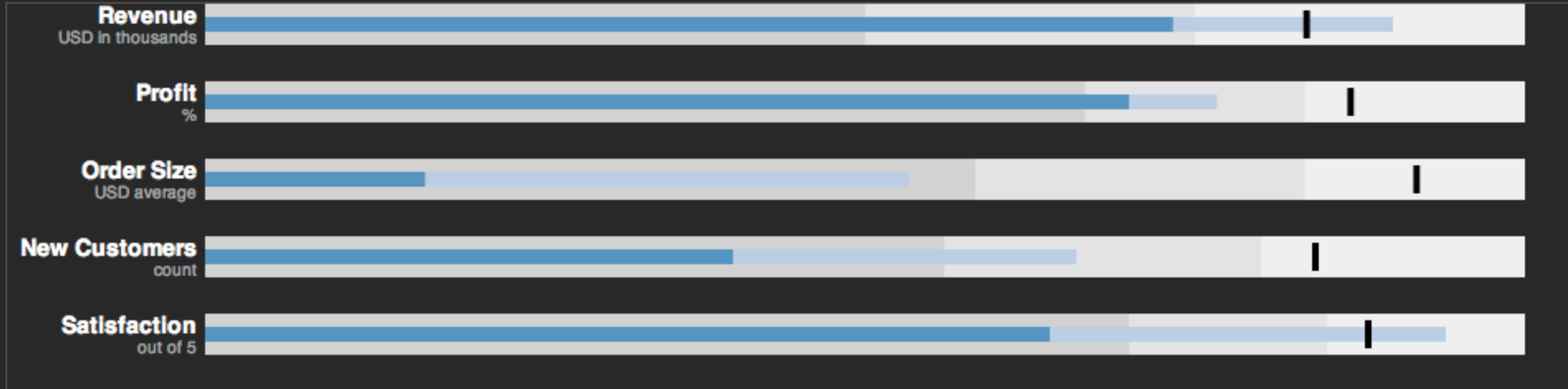
```
(ns choropleth
  (:use [c2.core :only [unify style]]
        [c2.maths :only [extent floor]]
        [c2.geo.core :only [geo->svg]])
```

# Boxplot



```
(ns boxplot
  (:use [c2.core :only [unify style]]
        [c2.maths :only [sin cos Tau extent]]
        [c2.util :only [half]]
```

# Bullet



```
(ns bullet
  (:use [c2.core :only [unify style]]
        [c2.util :only [half]])
  (:require [c2.scale :as scale]
            [vonnibus.color-brewer :as color-brewer]))
```

```
(def css "
.bullet { font: 10px sans-serif; }
.bullet .labels { fill: white; text-anchor: end; }
.bullet .marker { stroke: #000; stroke-width: 2px; }
```

```
.bullet .highlight { stroke: #ccc; stroke-width: 5px; }
```

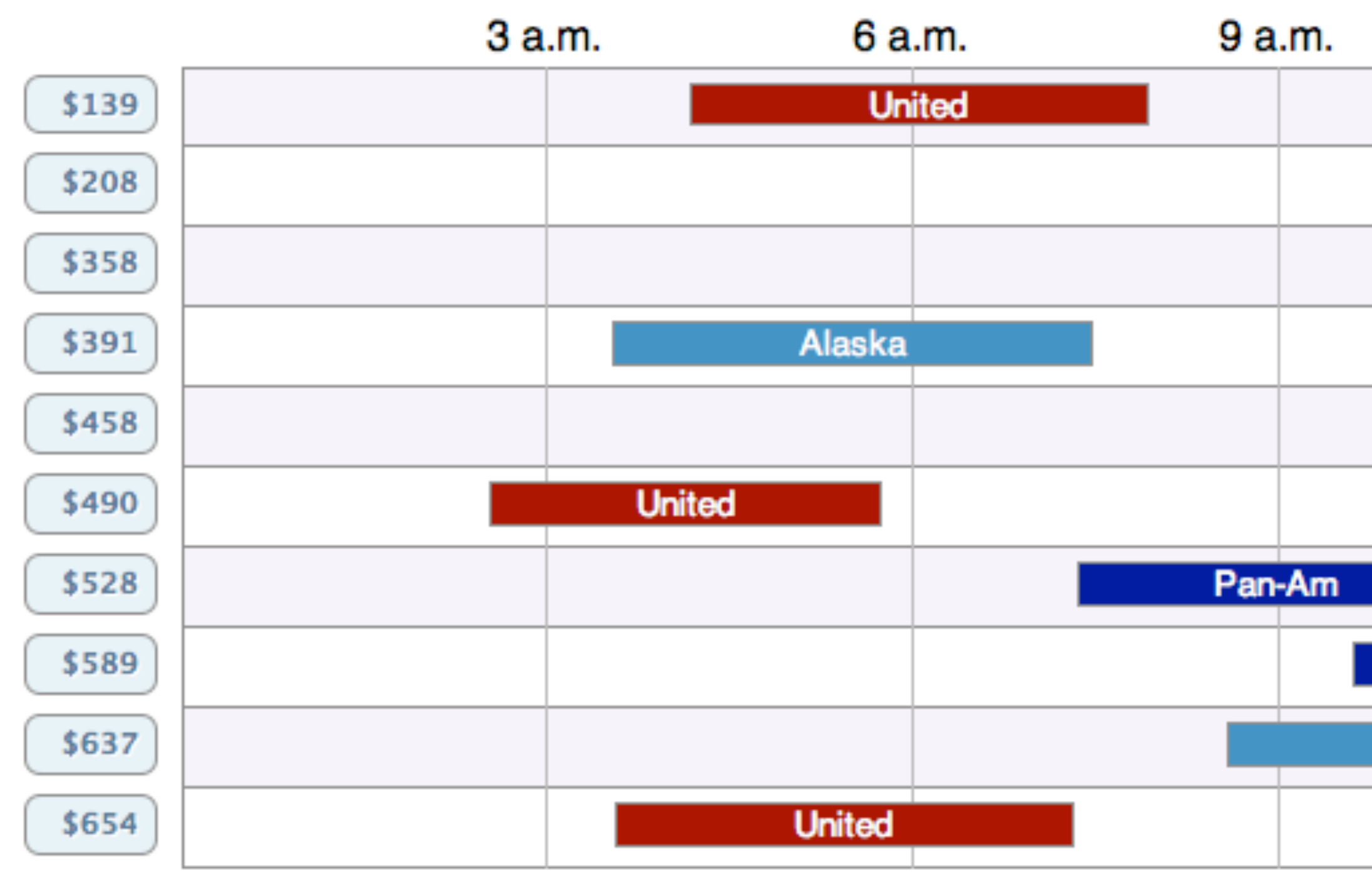


Bespoke  
vs.  
*Exploratory*



# Bespoke

Photo by **Scott Schuman**,  
*The Sartorialist*



```
#axis
```

```
.tick
```

```
position: absolute
```

```
height: 100%
```

```
.label
```

```
position: absolute
```

```
position: relative
```

```
top: -1.3em
```

```
left: -2.5em
```

```
width: 5em
```

```
text-align: center
```

```
font-family: sans-serif
```

```
.grid-line
```

```
position: absolute
```

```
width: 1px
```

```
height: 100%
```

```
top: 0px
```

```
background-color: hsl(0,0%,70%)
```

```
z-index: 1
```

```
#flights
```

```
flight
```

```
z-index: 2
```

```
transition: all 0.2s ease
```

```
.price
```

```
position: absolute
```

```
text-align: right
```

```
width: 50px
```

```
height: 80%
```

```
top: 10%
```

```
left: -60px
```

```
.flight
```

```
position: absolute
```

```
height: 60%
```

```
top: 20%
```

```
text-align: center
```

```
border: 1px solid gray
```

```
span
```

```
color: white
```

```
font-size: 0.8em
```

```
font-family: sans-serif
```

```
@mixin carrier-color($c)
```

```
.flight[carrier=#{$c}]
```

```
background-color: $c
```

```
(map flight-data
```

```
(fn [{:keys [price carrier depart arrive]})
```

```
[:div.row
```

```
[:button.price (str "$" price)]
```

```
[:div.flight
```

```
{:style {:left (time-scale depart)
```

```
:width (time-scale (- arrive depart))}
```

```
:carrier carrier}
```

```
[:span carrier]]))
```

```
(map [[3 "3 a.m." ] [6 "6 a.m." ] [9 "9 a.m." ]
```

```
[12 "Noon" ] [15 "3 p.m." ] [18 "6 p.m." ]])
```

```
(fn [[t label]]
```

```
[:div.tick {:style {:left (time-scale t)}}]
```

```
[:div.grid-line]
```

```
[:span.label label]]))
```

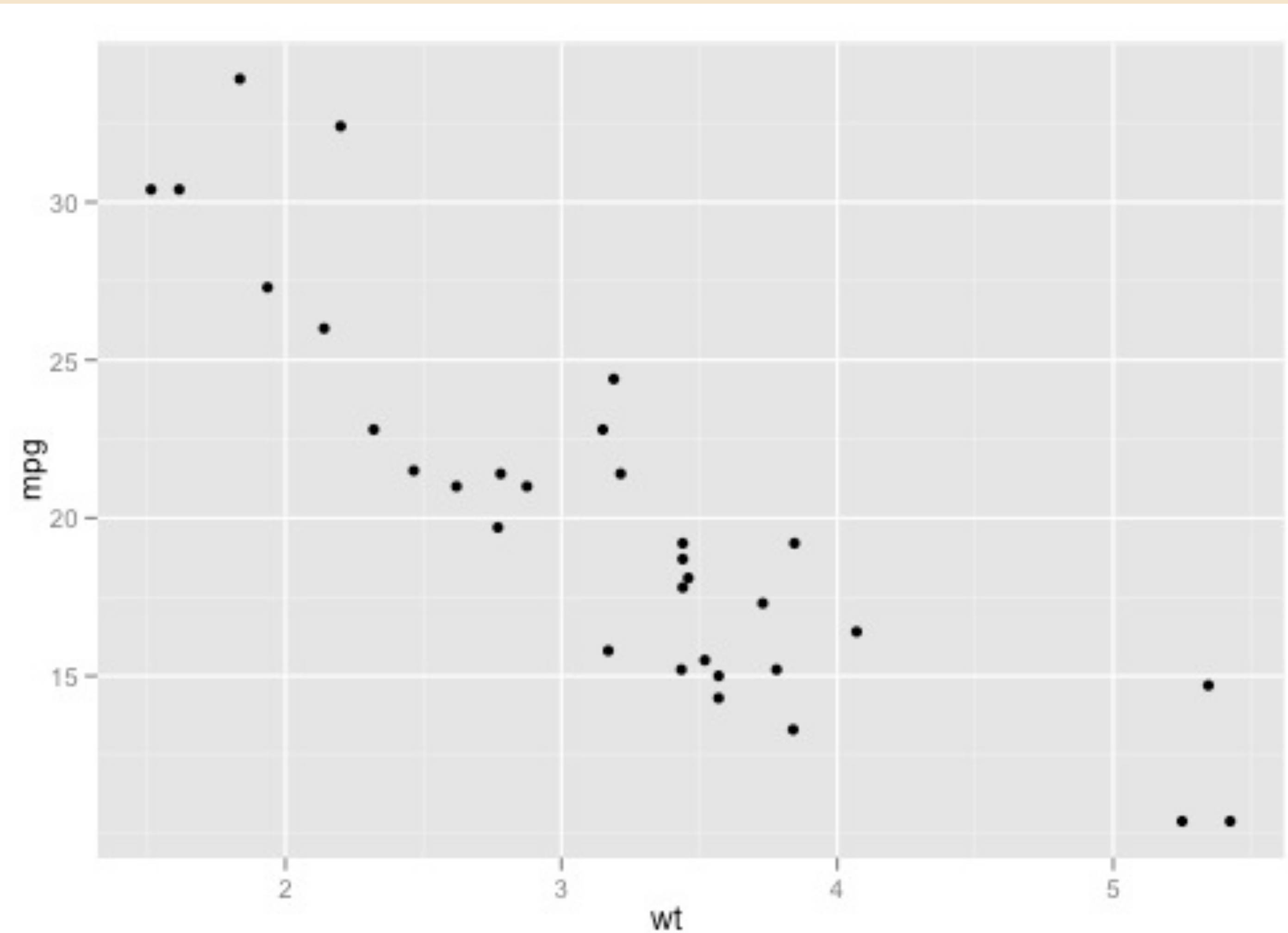


# *Exploratory*



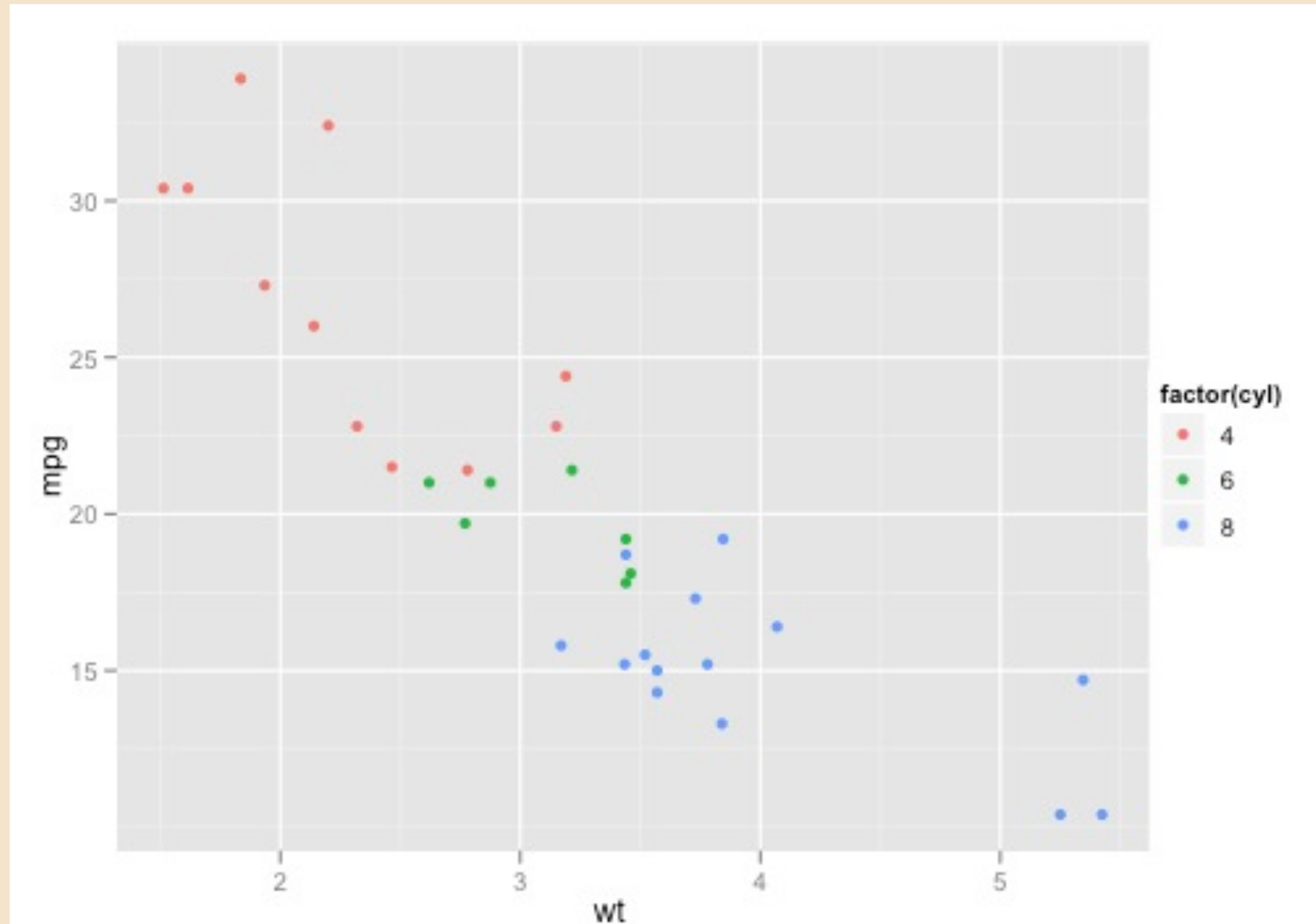
```
ggplot(mtcars, aes(wt, mpg))  
  + geom_point()
```

# *Exploratory*

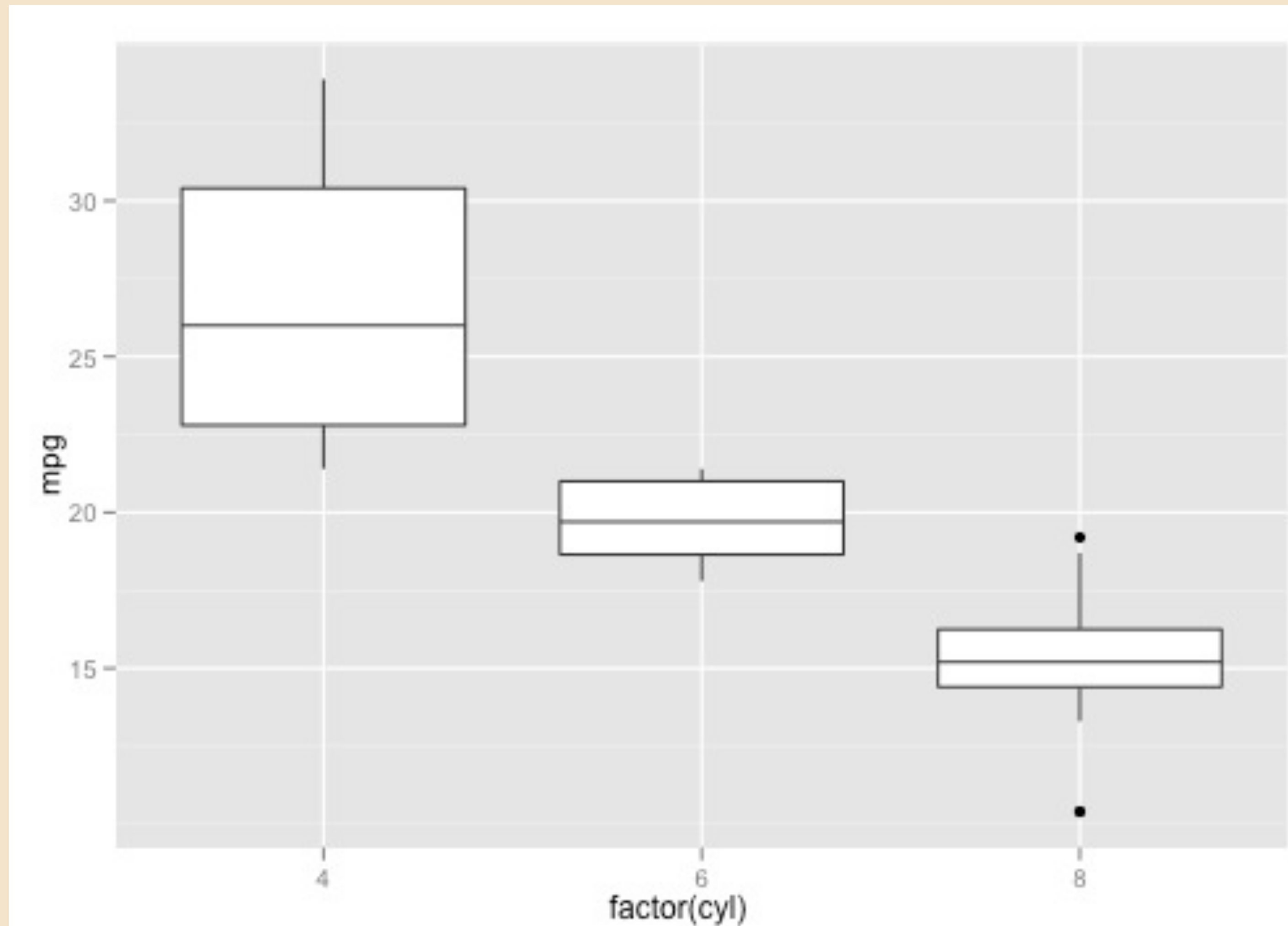


# Exploratory

```
ggplot(mtcars, aes(factor(cyl), mpg))  
  + geom_point(aes(colour = factor(cyl)))
```

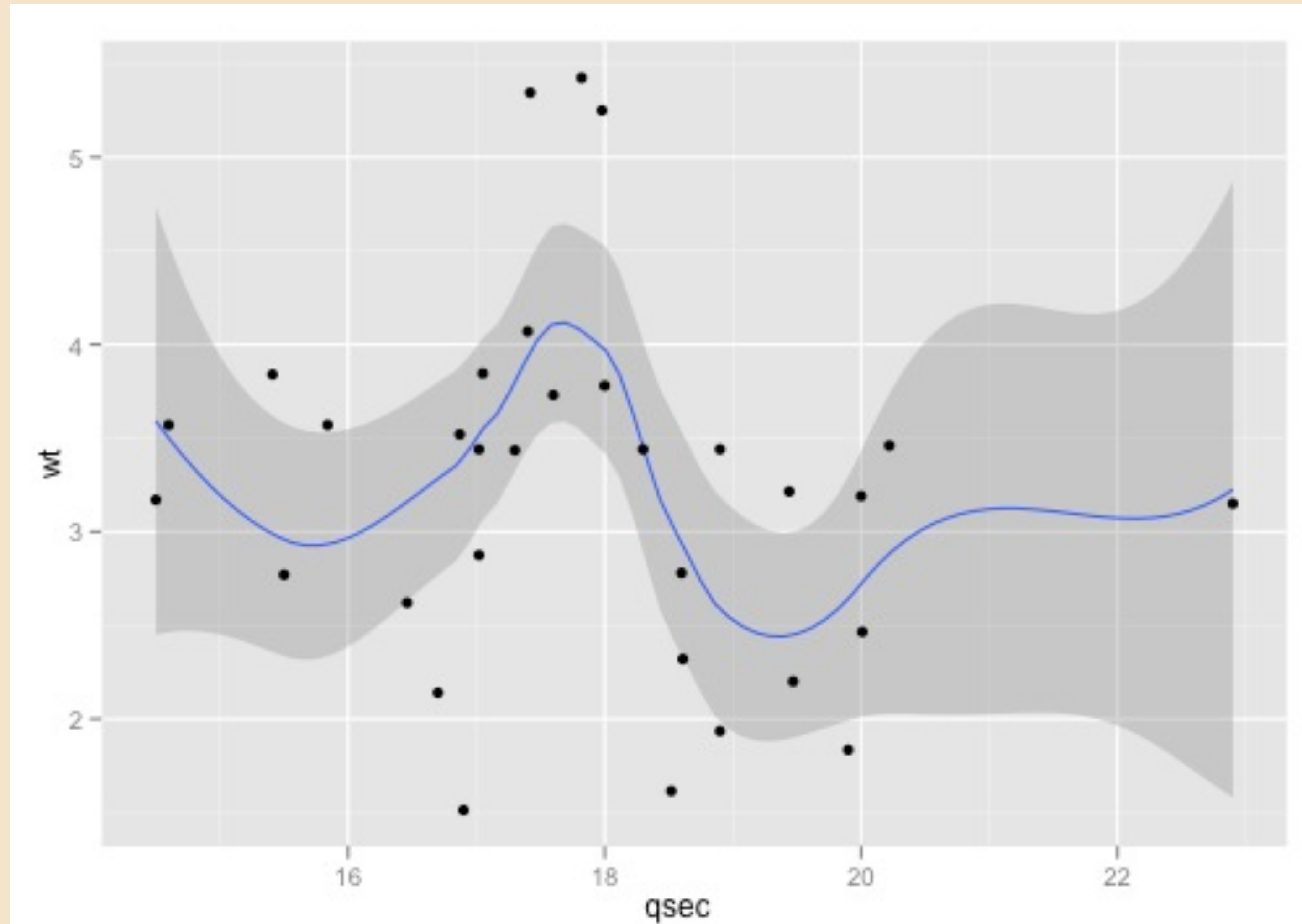


```
ggplot(mtcars, aes(wt, mpg))  
  + geom_boxplot()
```



```
ggplot(mtcars, aes(qsec, wt))  
  + stat_smooth() + geom_point()
```

# *Exploratory*



*Internets*

D3 C2



ggplot2



**R** *Grammar  
of Graphics*

# Kevin Lynagh

Keming Labs @lynaghk

