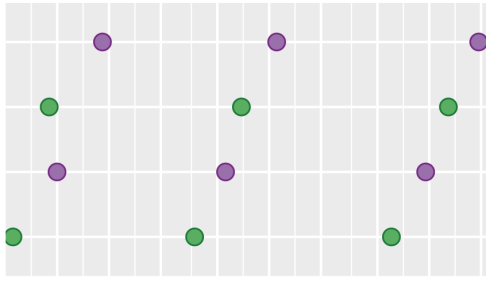
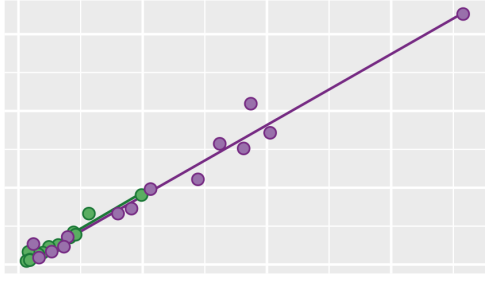
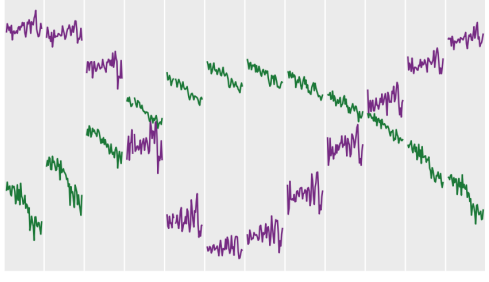
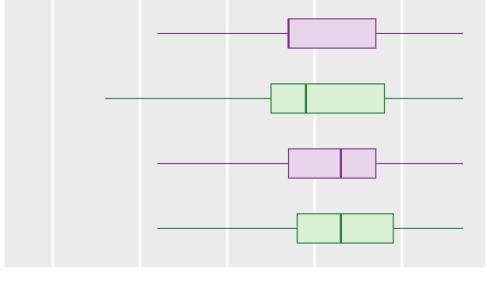








Expanding your graphical repertoire

Variables, design, message

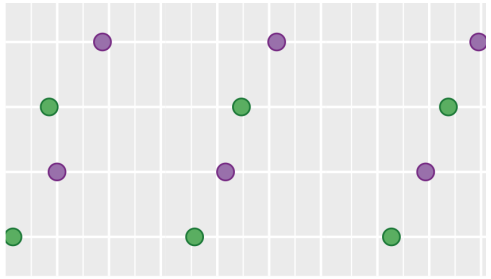
2023 MIDFIELD Institute

Richard Layton

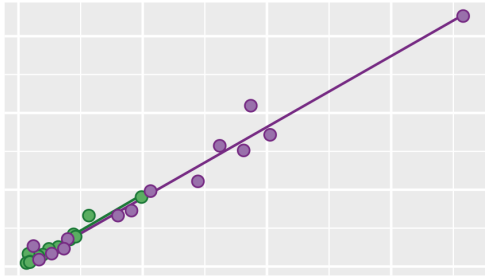
https://www.graphdoctor.com

https://github.com/graphdr

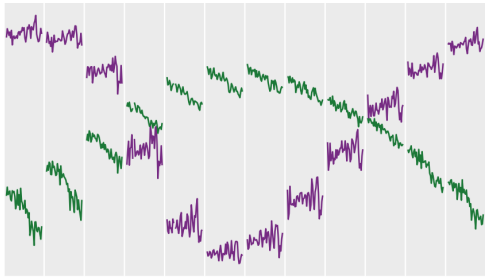
graphdoctor@gmail.com



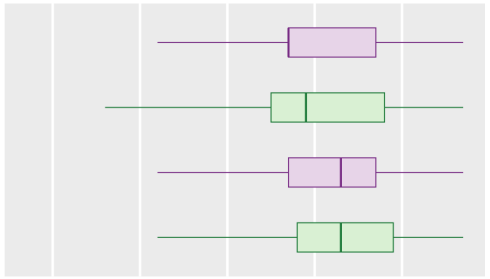
Comparing data



Revealing correlations



Showing evolution



Displaying distributions

Optimal design categories from: Jean-luc Doumont (2009) *Trees, Maps and Theorems*, Principiae, p. 133.

Comparing data

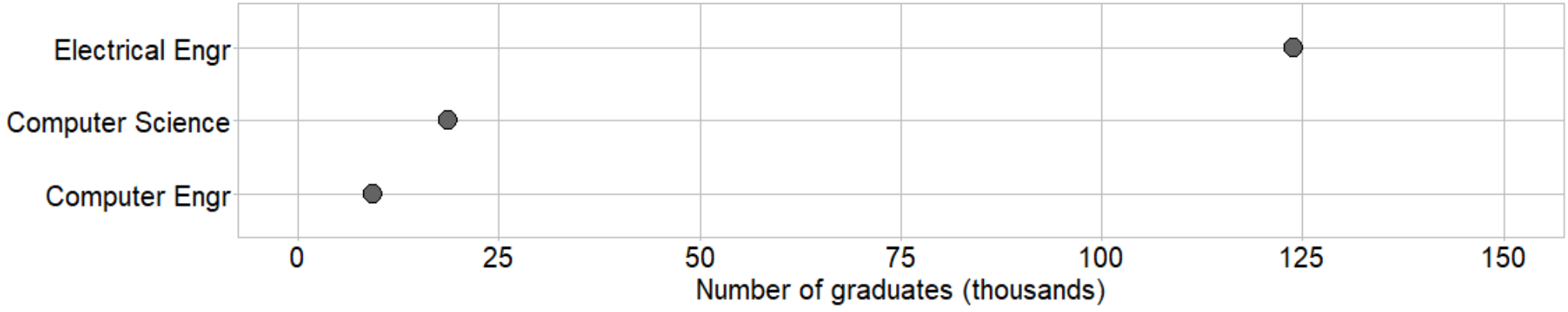
Data

Representation at graduation in 3 engineering programs, 19 US institutions, 1987–2018

Origin	Sex	Electrical Engr	Computer Engr	Computer Science
Domestic	Female	23426	702	2923
Domestic	Male	90150	7481	13987
International	Female	1865	140	365
International	Male	8530	993	1442

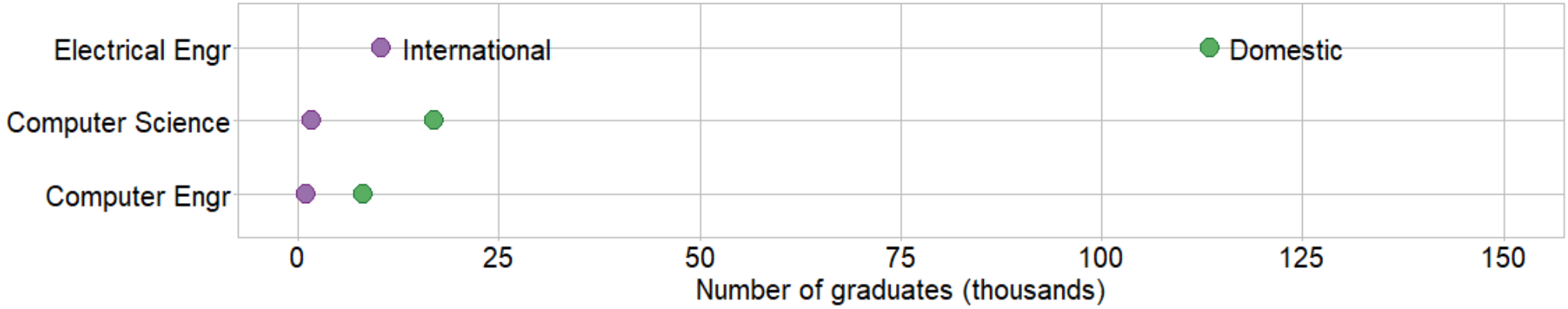
Data source: 2022 MIDFIELD

Dot chart



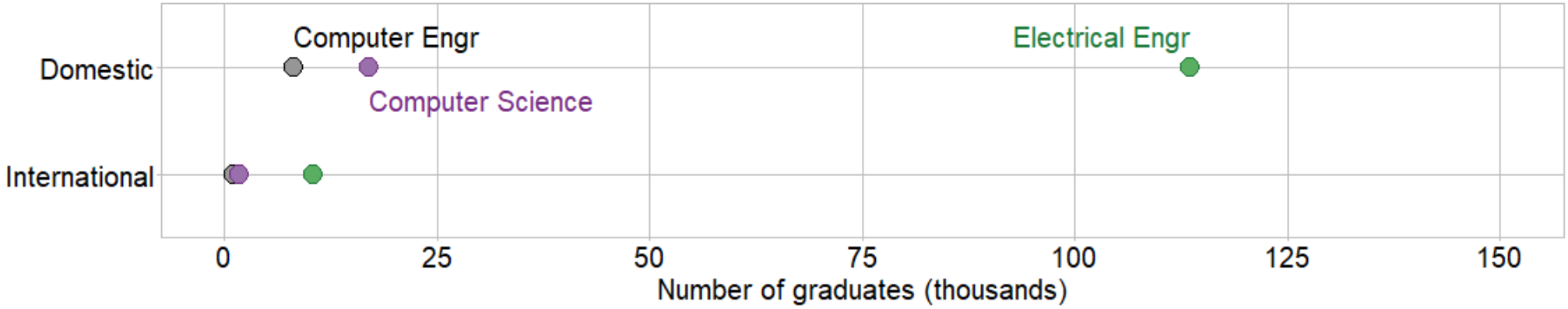
variable	type
program	categorical
count of graduates	quantitative

Add a second category

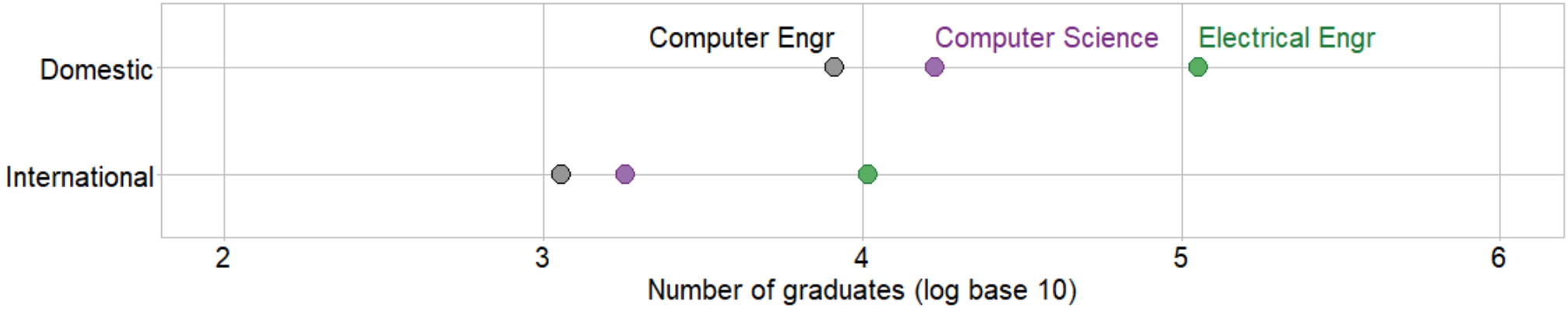


variable	type
program	categorical
origin	categorical
count of graduates	quantitative

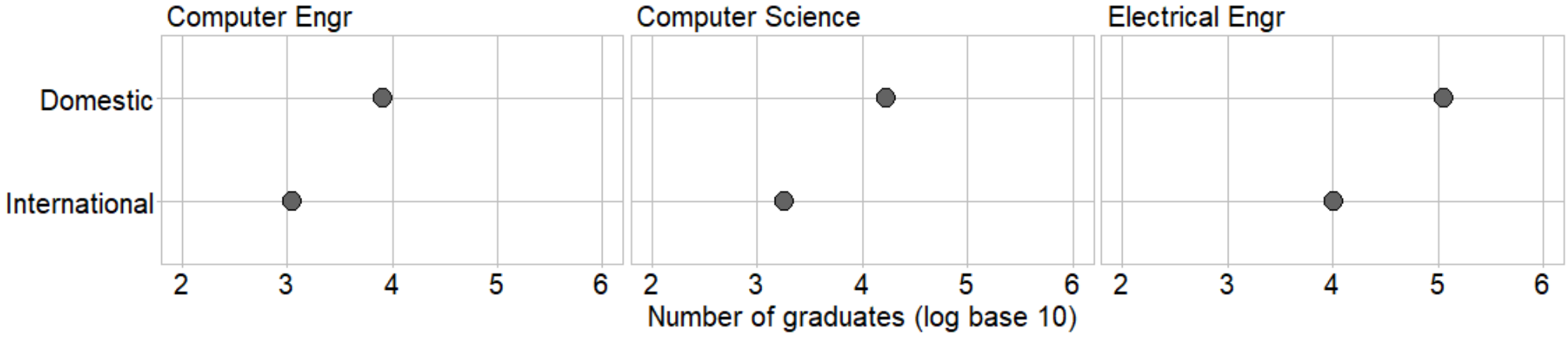
Exchange mapping of categorical variables



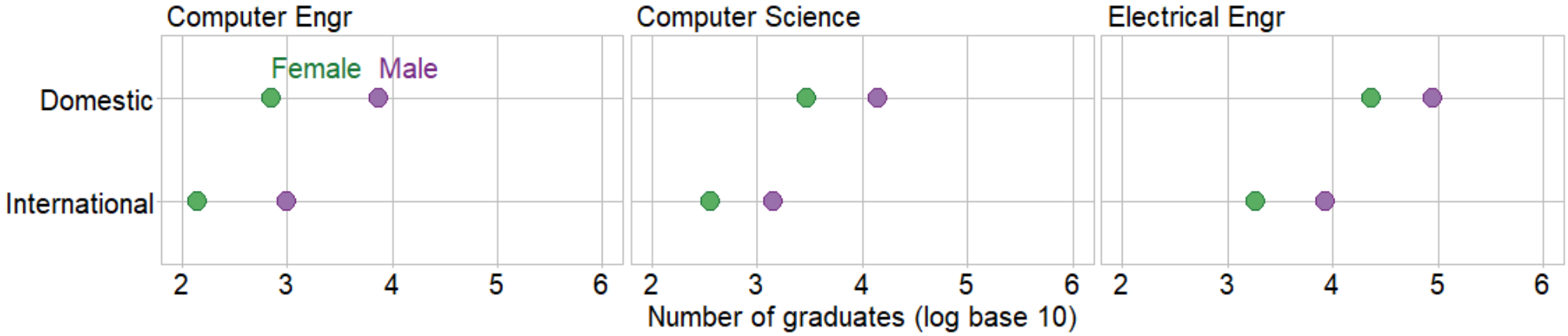
Logarithmic scale for orders of magnitude differences



One program per facet

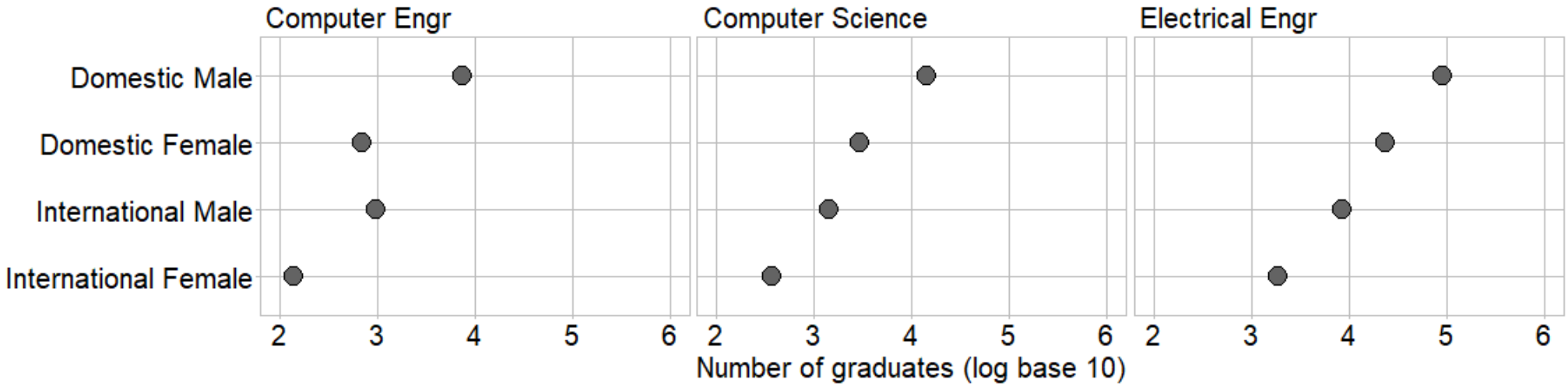


Add a third category



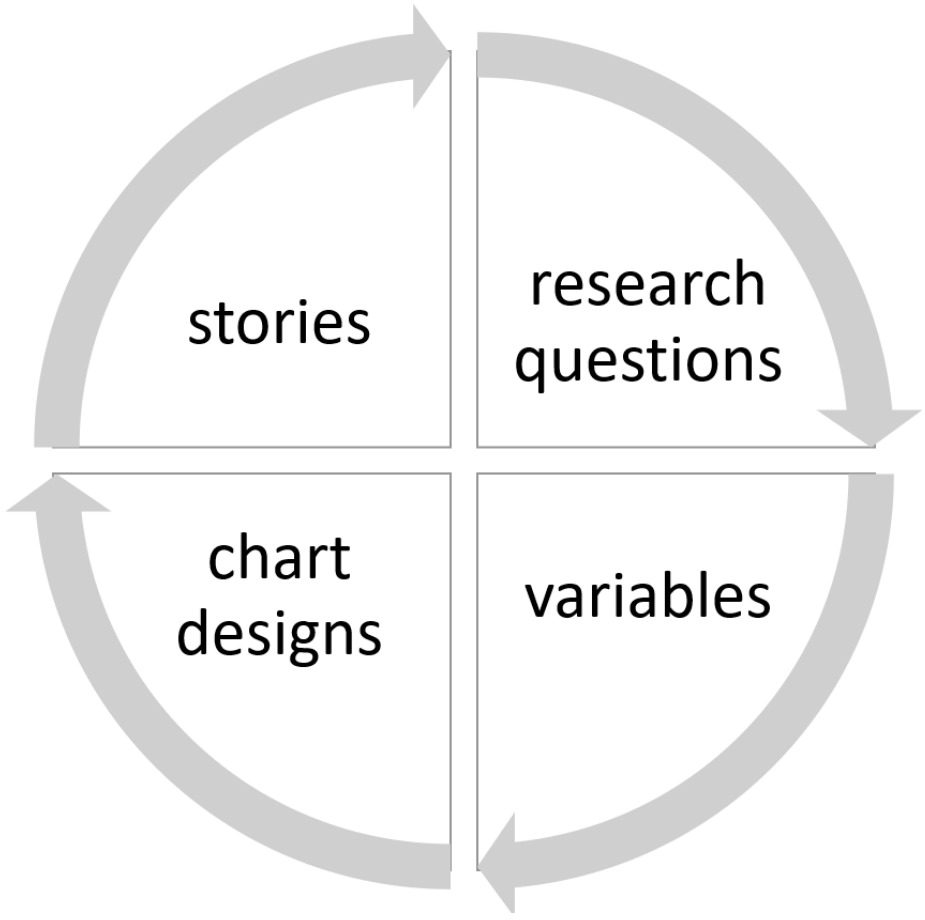
variable	type
program	categorical
origin	categorical
sex	categorical
count of graduates	quantitative

Combine categories



variable	type
origin/sex	categorical
program	categorical
count of graduates	quantitative

Discussion



Comparing data

What points seem most important to you so far?

Revealing correlations

Data

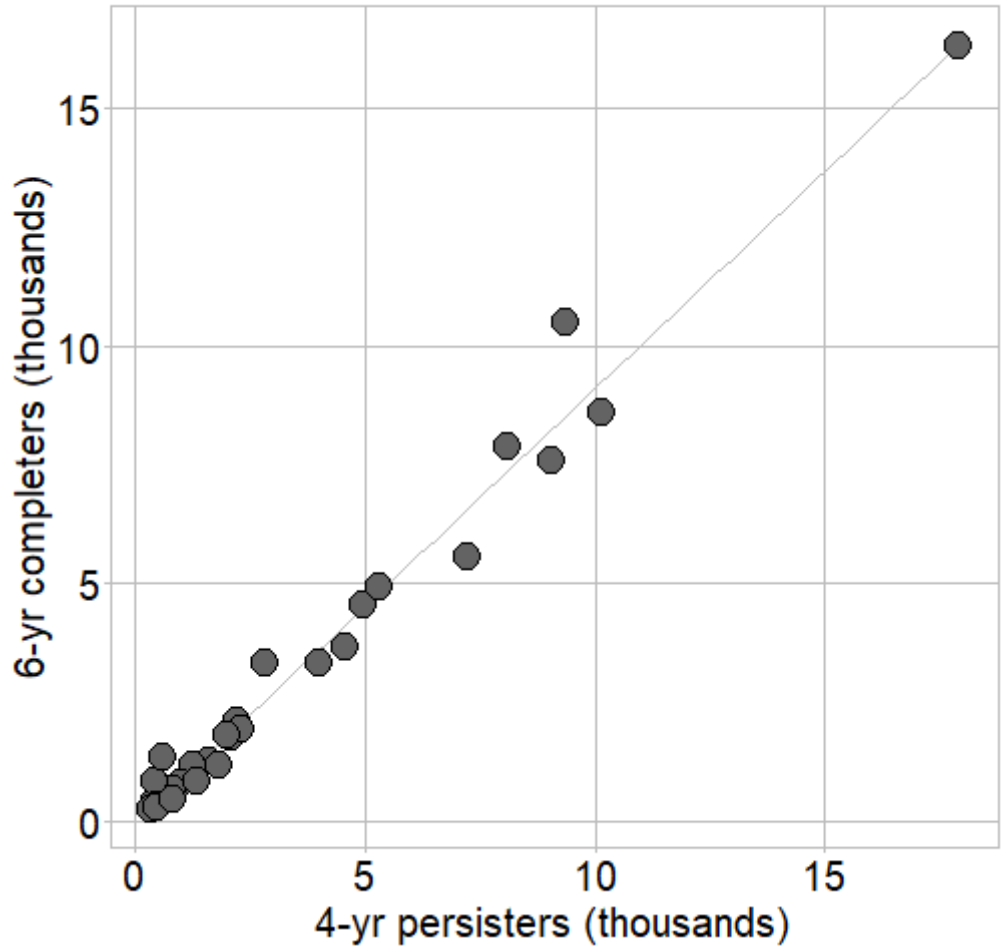
Engineering students at 14 institutions persisting to year 4 and graduating by year 6, 1987--2019

```
    institution    sex    y4    y6
         <char> <char> <int> <int>
 1:           A Female  4953  4525
 2:           A   Male 17897 16312
 3:           B Female  2834  3316
 4:           B   Male  9351 10473
 5:           C Female  2071  1764
 6:           C   Male 10128  8575
 7:           D Female  2217  2096
 8:           D   Male  8099  7863
---
21:           L Female   401   824
22:           L   Male   602  1332
23:           M Female   462   319
24:           M   Male  1829  1160
25:           N Female   322   228
26:           N   Male  1338   838
27:           P Female   457   283
28:           P   Male   827   447
```

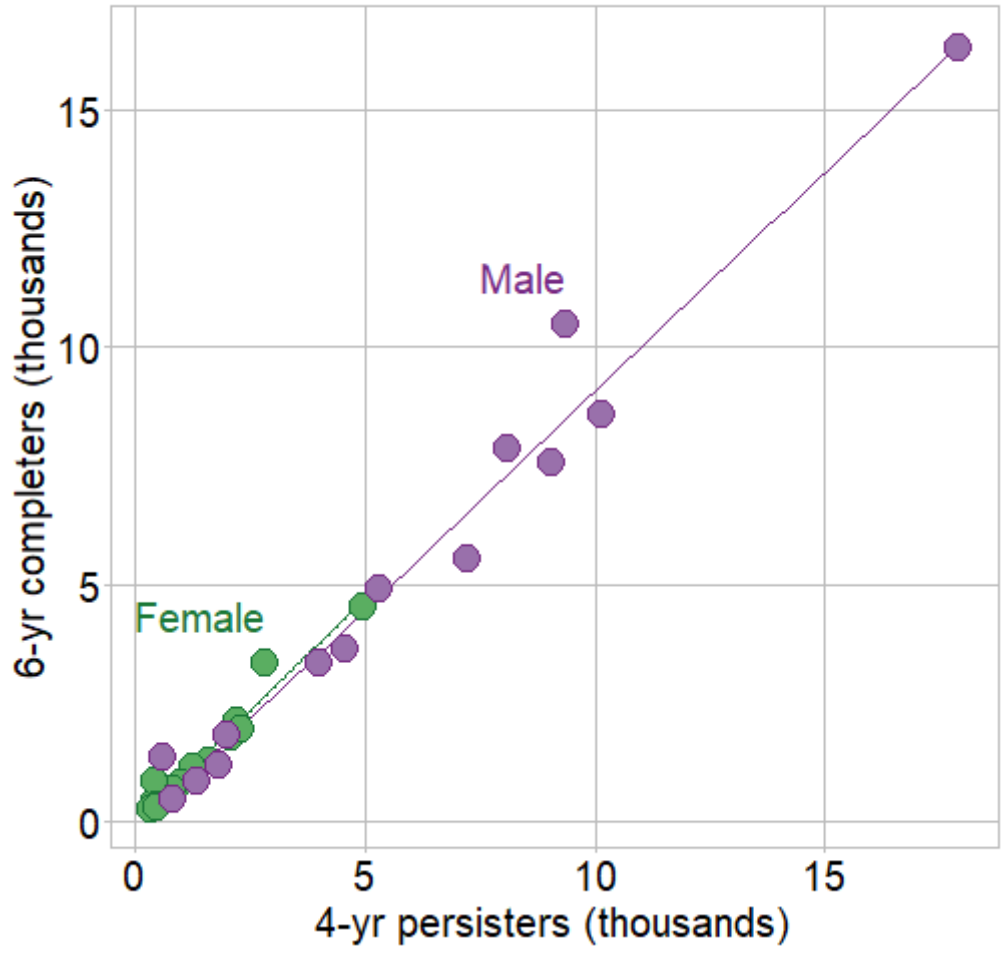
variable	type
institution	categorical
sex	categorical
4-yr persisters	quantitative
6-yr completers	quantitative

Data source: 2022 MIDFIELD

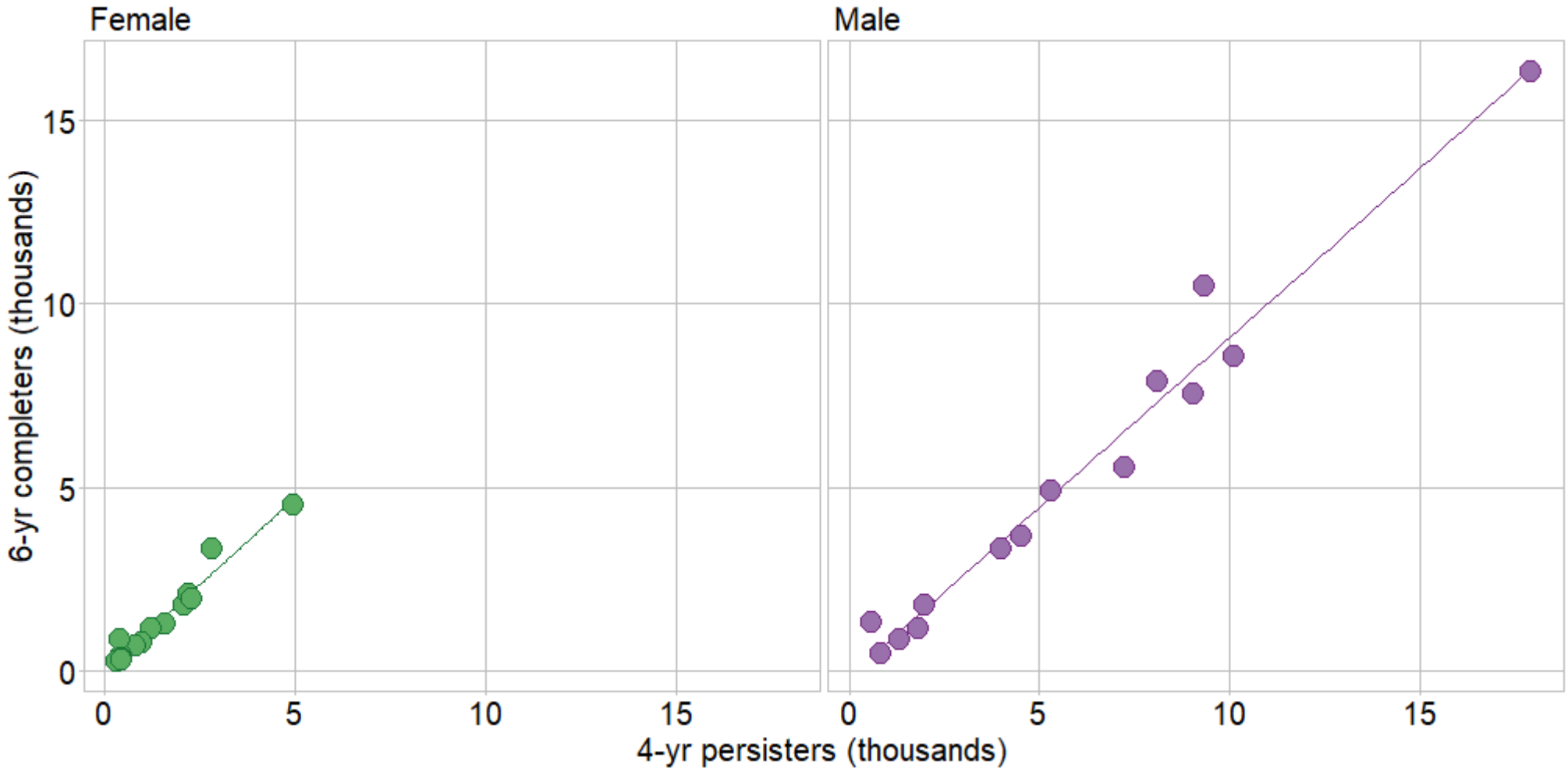
Scatterplots are designed to reveal correlation



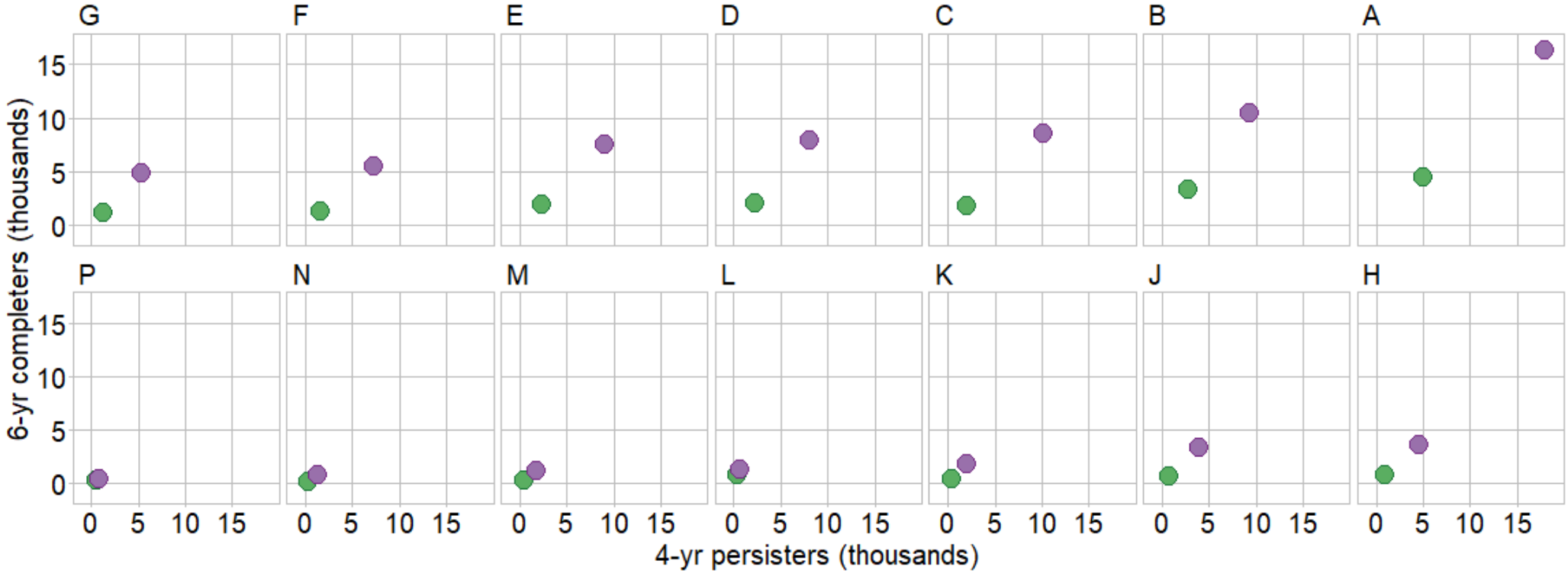
Add a category



One facet per sex

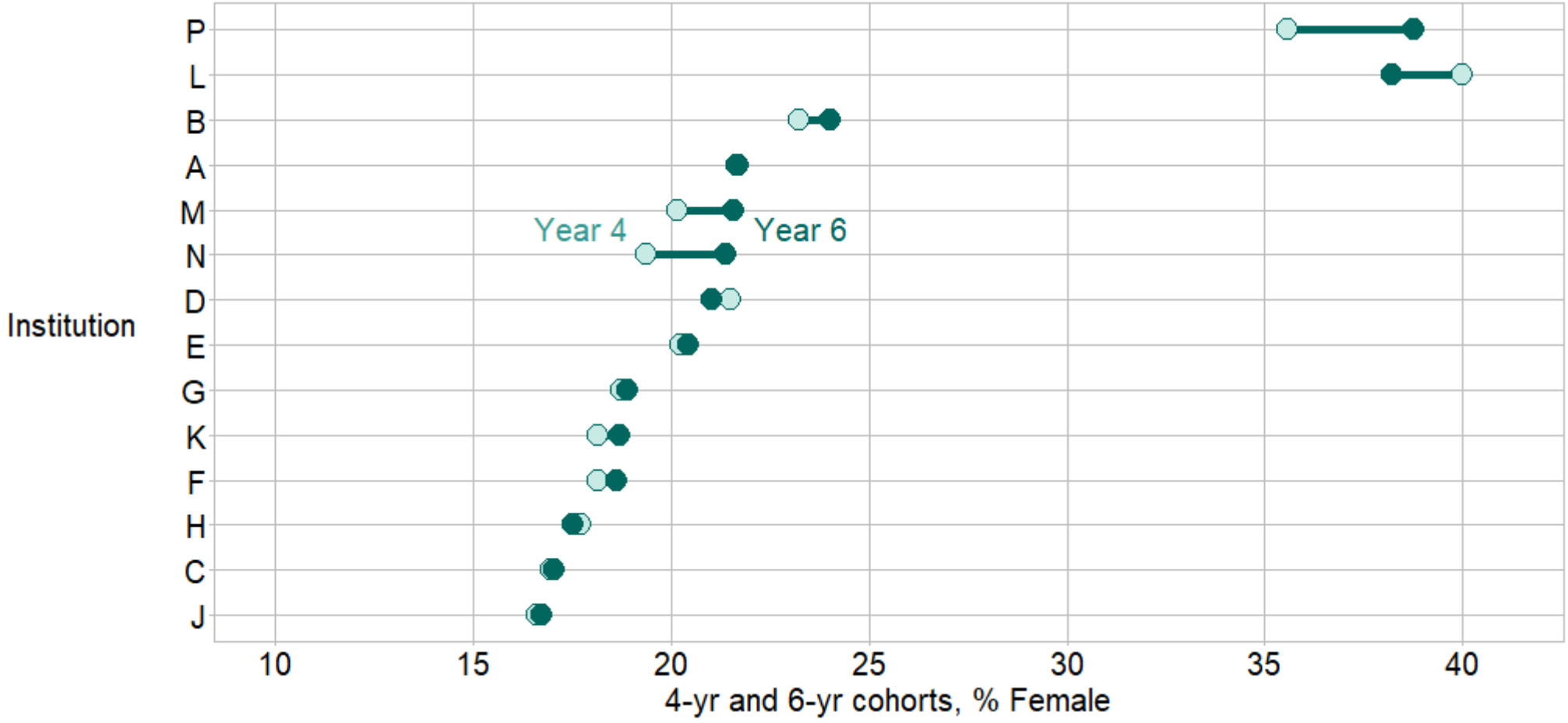


One facet per institution

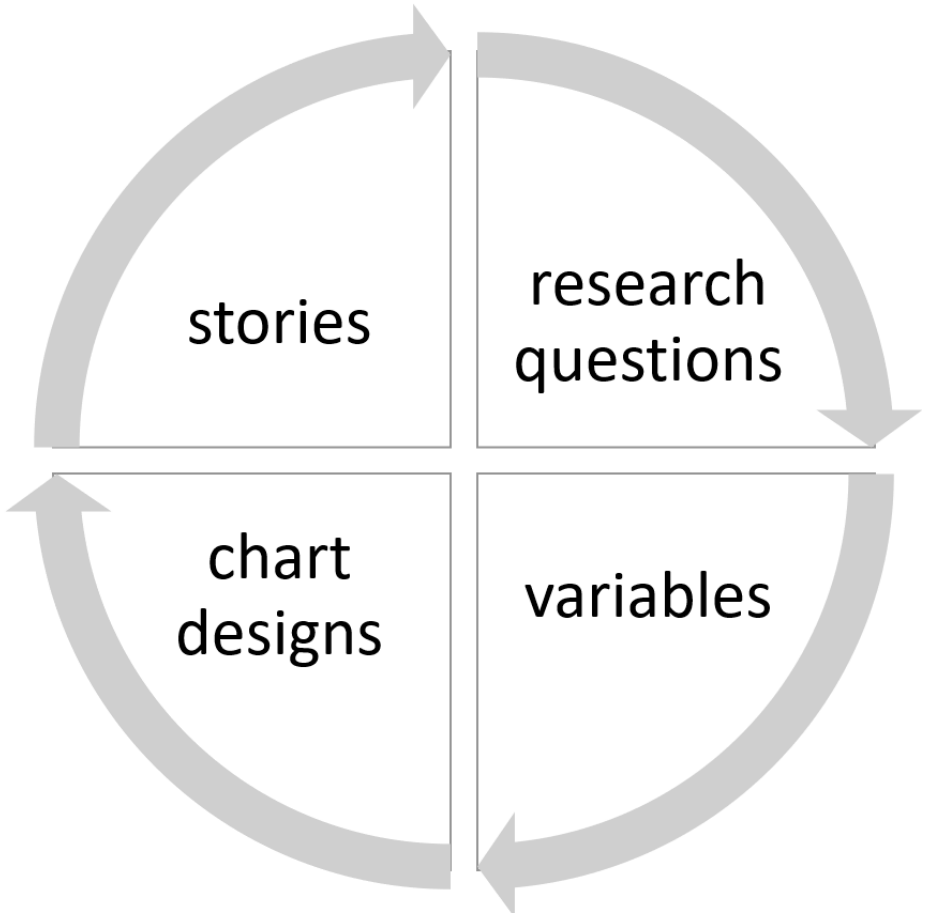


Change the quantitative variable

Engineering students at 14 institutions persisting to year 4 and graduating by year 6, 1987–2019



Discussion



Revealing correlations

We saw a correlation.

We changed the emphasis.

Which chart tells a more compelling story?

Showing evolution

Data

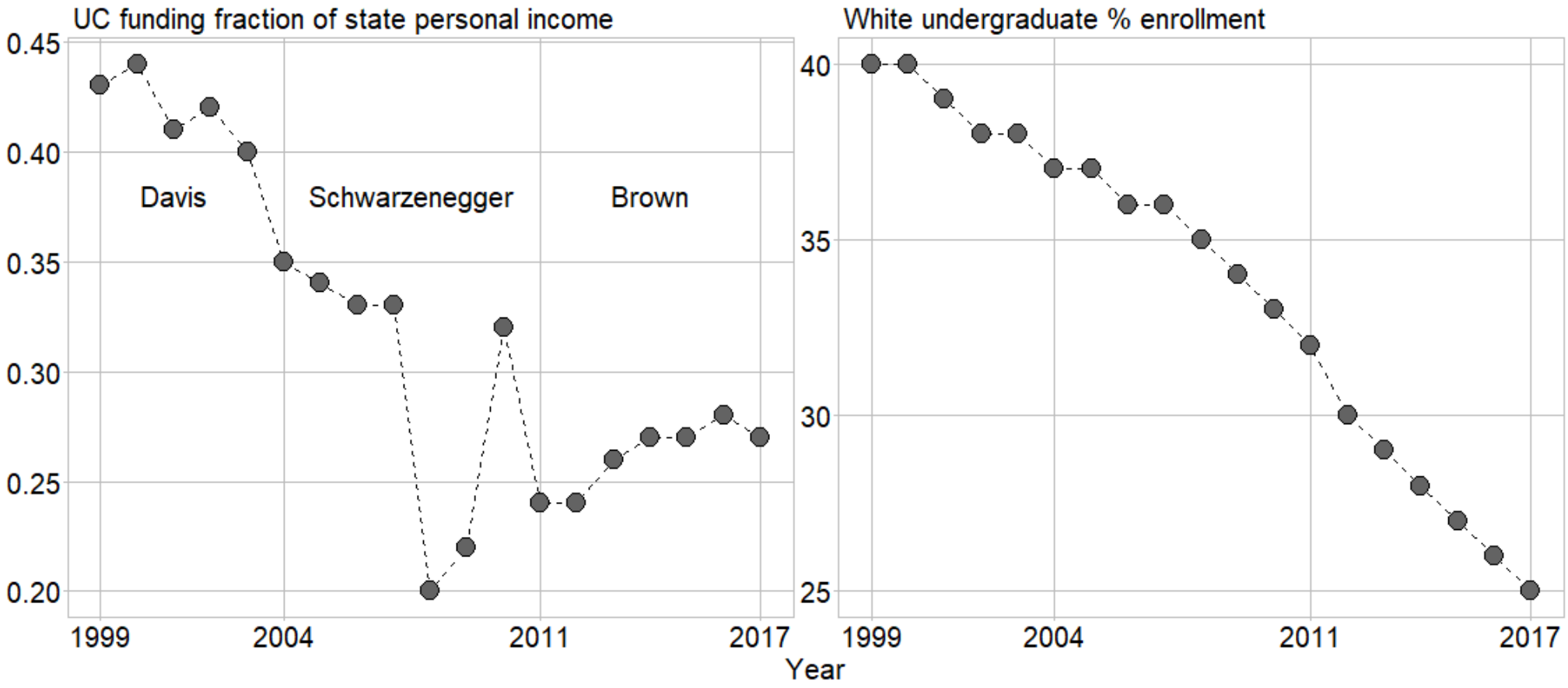
University of California: funding and percent White enrollment, 1999–2017

	year	gov	white_pct	fund_frac
	<num>	<char>	<num>	<num>
1:	1999	Davis	40	0.43
2:	2000	Davis	40	0.44
3:	2001	Davis	39	0.41
4:	2002	Davis	38	0.42
5:	2003	Davis	38	0.40
6:	2004	Schwarzenegger	37	0.35
7:	2005	Schwarzenegger	37	0.34
8:	2006	Schwarzenegger	36	0.33
9:	2007	Schwarzenegger	36	0.33
10:	2008	Schwarzenegger	35	0.20
11:	2009	Schwarzenegger	34	0.22
12:	2010	Schwarzenegger	33	0.32
13:	2011	Brown	32	0.24
14:	2012	Brown	30	0.24
15:	2013	Brown	29	0.26
16:	2014	Brown	28	0.27
17:	2015	Brown	27	0.27
18:	2016	Brown	26	0.28
19:	2017	Brown	25	0.27

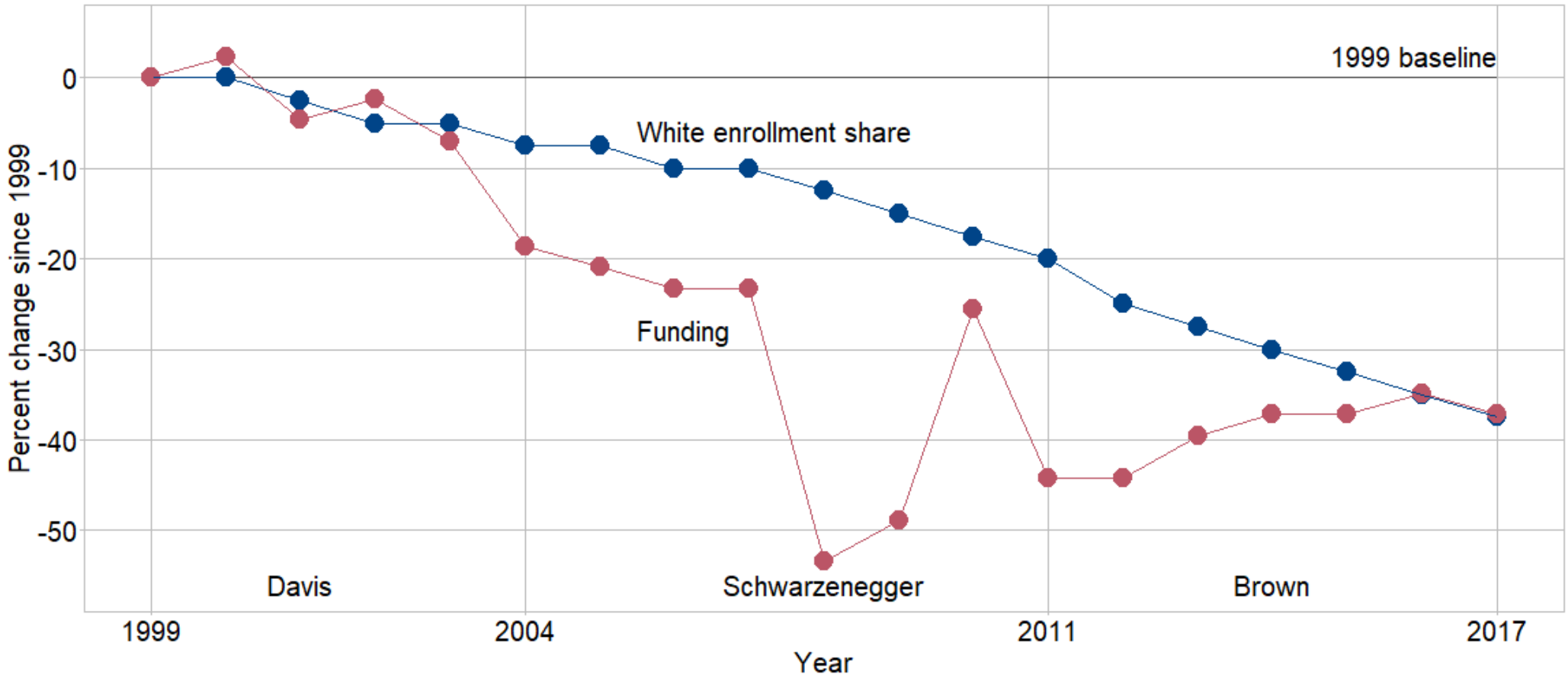
variable	type
year	categorical
governor	categorical
UC funding metric	quantitative
White undergraduate % enrollment	quantitative

Data source: C. Newfield (2021) Budget justice: Addressing the structural racism of higher education funding, *Academe* 107(2), 57–64.

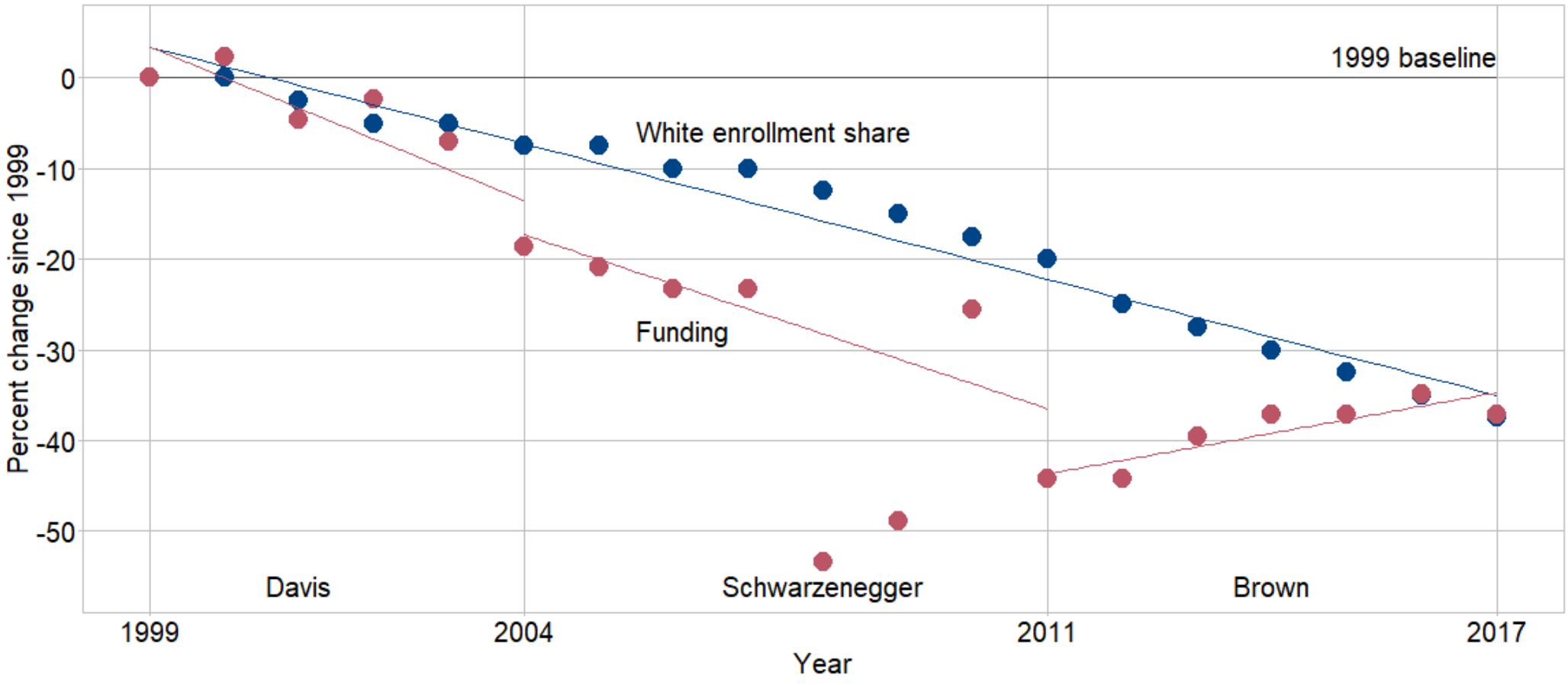
Two time series



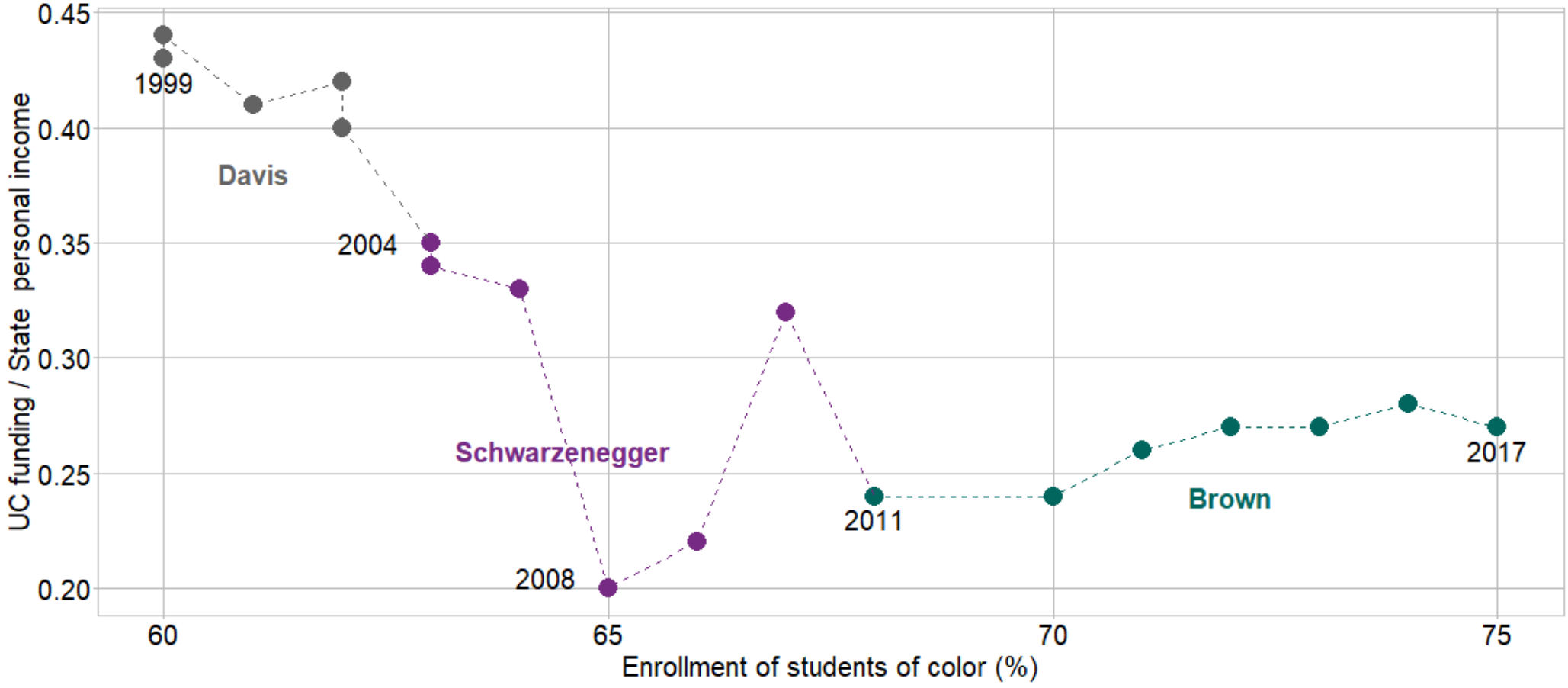
Indexed time series



Parallel lines indicate possible correlation



Connected scatterplot



Data

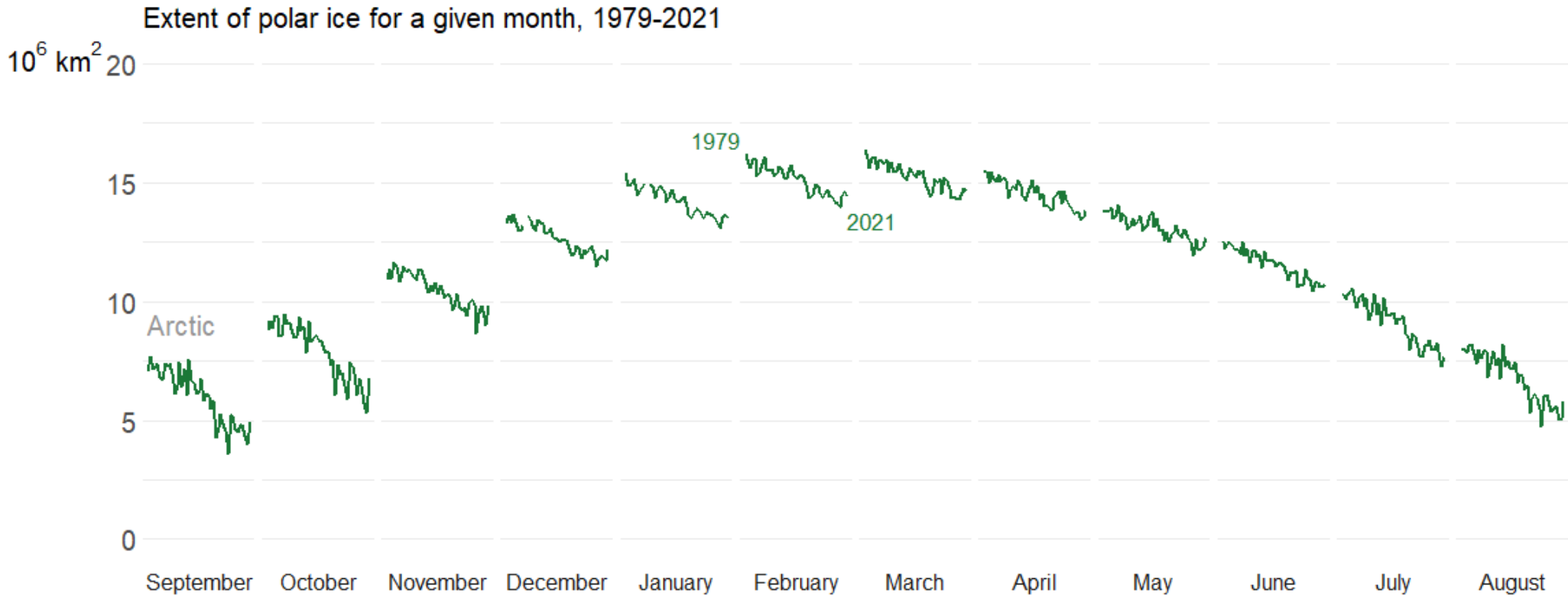
Extent of polar ice, 1979–2021

```
         hemis     month  year extent
        <char>    <fctr> <int>  <num>
   1:    Arctic September  1979  7.051
   2:    Arctic September  1980  7.667
   3:    Arctic September  1981  7.138
   4:    Arctic September  1982  7.302
   5:    Arctic September  1983  7.395
   6:    Arctic September  1984  6.805
   7:    Arctic September  1985  6.698
   8:    Arctic September  1986  7.411
   9:    Arctic September  1987  7.279
  10:    Arctic September  1988  7.369
  ---
1023: Antarctic    August  2012 18.097
1024: Antarctic    August  2013 18.664
1025: Antarctic    August  2014 18.908
1026: Antarctic    August  2015 17.749
1027: Antarctic    August  2016 17.892
1028: Antarctic    August  2017 17.219
1029: Antarctic    August  2018 17.417
1030: Antarctic    August  2019 17.478
1031: Antarctic    August  2020 17.758
1032: Antarctic    August  2021 18.131
```

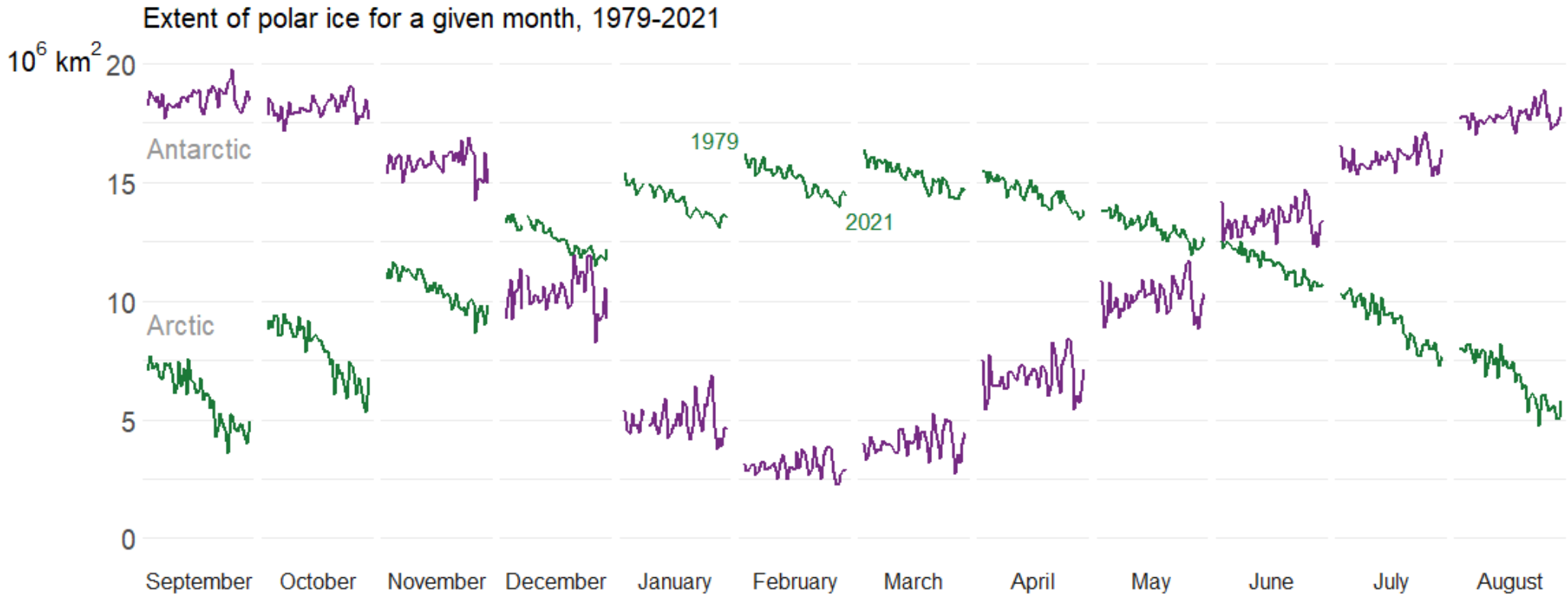
variable	type
hemisphere	categorical
month	categorical
year	categorical
area of polar ice (millions sq km)	quantitative

Data source: NASA National Snow and Ice Data Center Sea ice extent and area organized by year

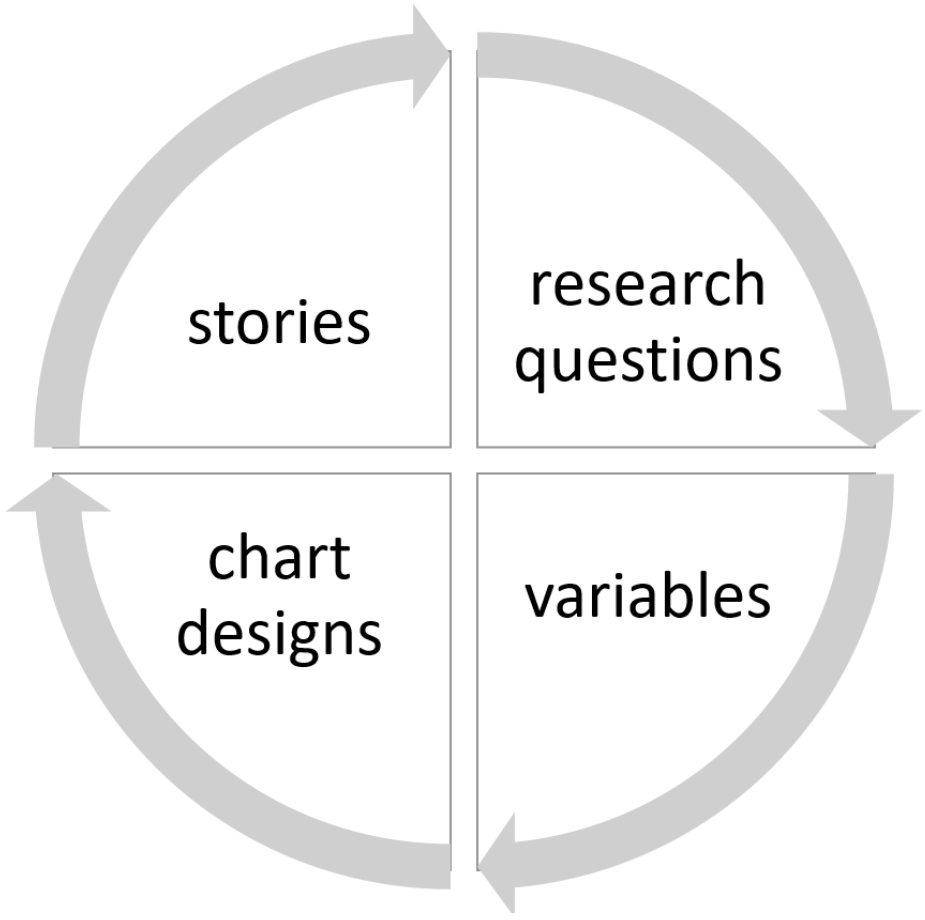
Cyclic time series



Add a category



Discussion



Showing evolution

Which time series chart design might be used in your own work? Explain.

Displaying distributions

Data

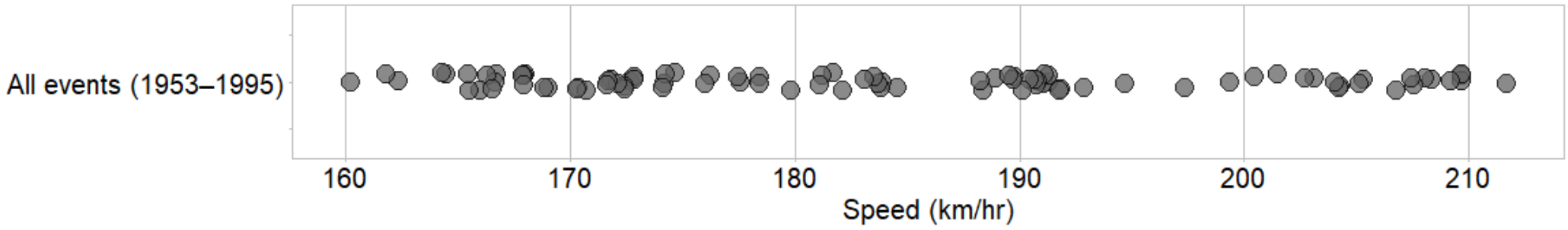
World speed skiing competitions, 1953–1995

```
             Event  Year    Sex  Speed
            <fctr> <int> <fctr>  <num>
 1: Speed Downhill  1952   Male 167.85
 2: Speed Downhill  1953   Male 168.86
 3: Speed Downhill  1961   Male 165.42
 4: Speed Downhill  1962   Male 172.85
 5: Speed Downhill  1965   Male 189.77
 6: Speed Downhill  1965   Male 172.44
 7: Speed Downhill  1966   Male 176.01
 8: Speed Downhill  1967   Male 188.29
 9: Speed Downhill  1967   Male 172.15
10: Speed Downhill  1969   Male 192.86
---
82:      Speed One  1982   Male 206.80
83:      Speed One  1982   Male 191.29
84:      Speed One  1985 Female 202.70
85:      Speed One  1985   Male 209.69
86:      Speed One  1987   Male 209.70
87:      Speed One  1990 Female 201.51
88:      Speed One  1990 Female 199.35
89:      Speed One  1991   Male 207.59
90:      Speed One  1993   Male 208.33
91:      Speed One  1993   Male 170.30
```

variable	type
event	categorical
year	categorical
sex	categorical
speed (km/hr)	quantitative

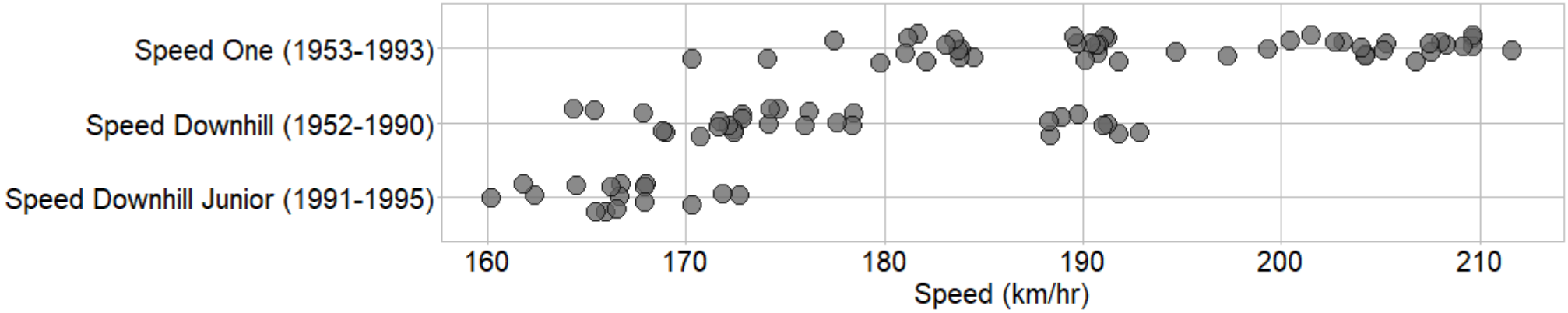
Data source: 2011 World speed skiing competition, in the GDAdata R package

Strip chart



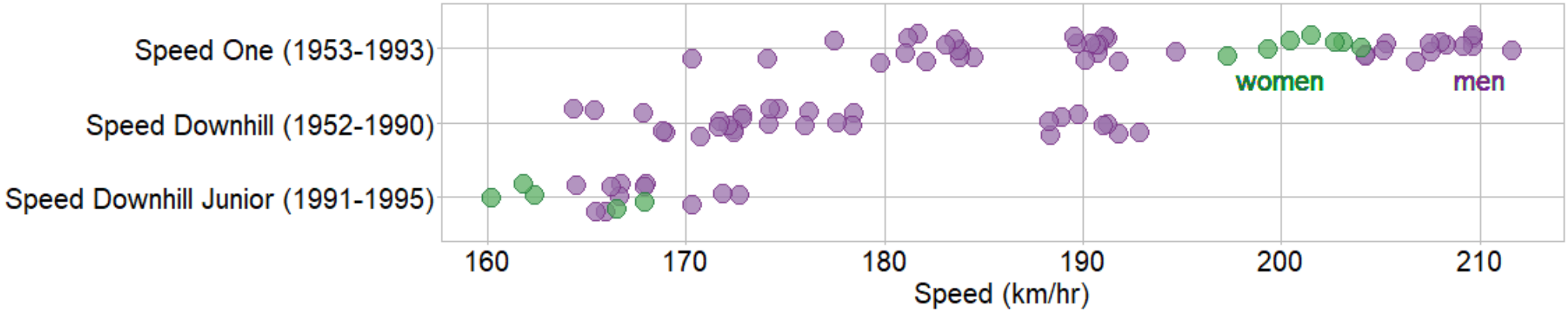
variable	type
speed	quantitative

Add a category



variable	type
event	categorical
speed	quantitative

Add a second category



variable	type
event	categorical
sex	categorical
speed	quantitative

Data

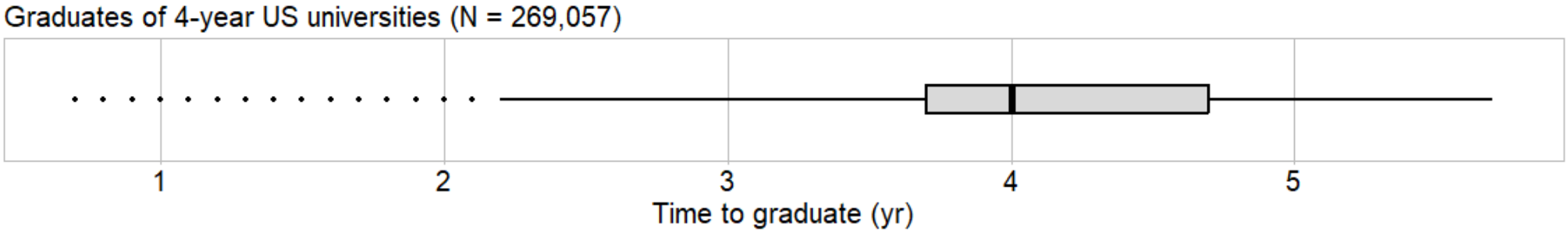
MIDFIELD graduates (N = 270k), enrolled in Engineering, excluding 10th and 90th quantiles

```
                path    sex years_to_grad
               <char> <char>         <num>
     1: Nontraditional Female           3.9
     2: Nontraditional Female           1.9
     3: Nontraditional Female           3.9
     4: Nontraditional Female           5.3
     5: Nontraditional Female           5.1
     6: Nontraditional Female           3.8
     7: Nontraditional Female           2.7
     8: Nontraditional Female           1.9
     9: Nontraditional Female           2.8
    10: Nontraditional Female           3.9
    ---
269048:    Traditional   Male           5.7
269049:    Traditional   Male           1.7
269050:    Traditional   Male           3.7
269051:    Traditional   Male           4.7
269052:    Traditional   Male           5.7
269053:    Traditional   Male           2.6
269054:    Traditional   Male           1.3
269055:    Traditional   Male           3.0
269056:    Traditional   Male           5.3
269057:    Traditional   Male           0.7
```

variable	type
path	categorical
sex	categorical
years to graduate	quantitative

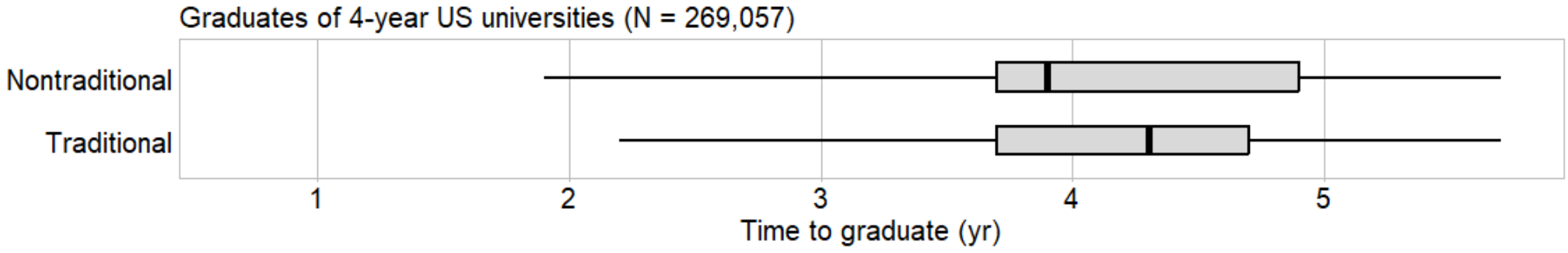
Data source: MIDFIELD subset from the graphclassmate R package

Box and whisker chart



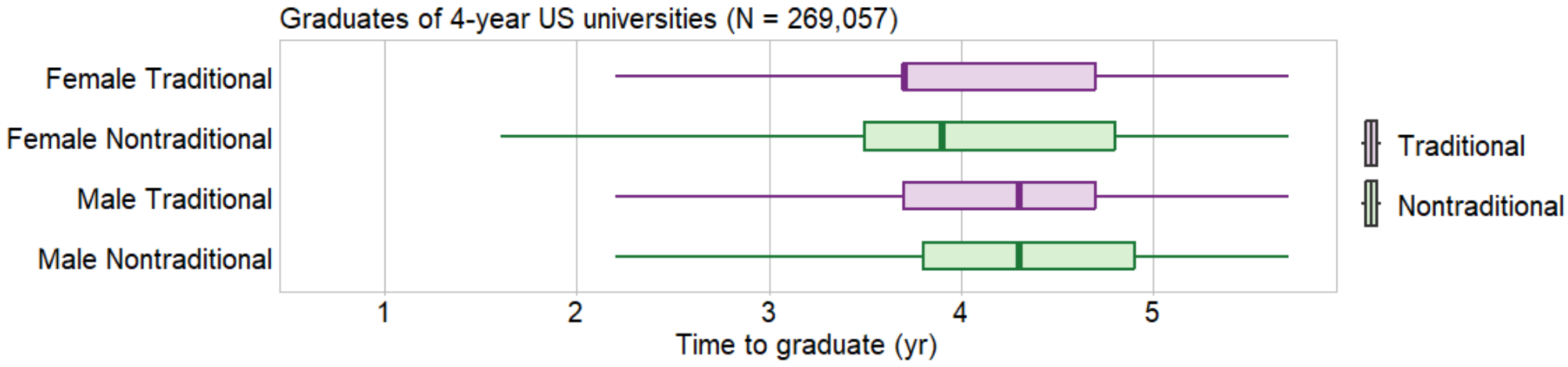
variable	type
years to graduate	quantitative

Add a category



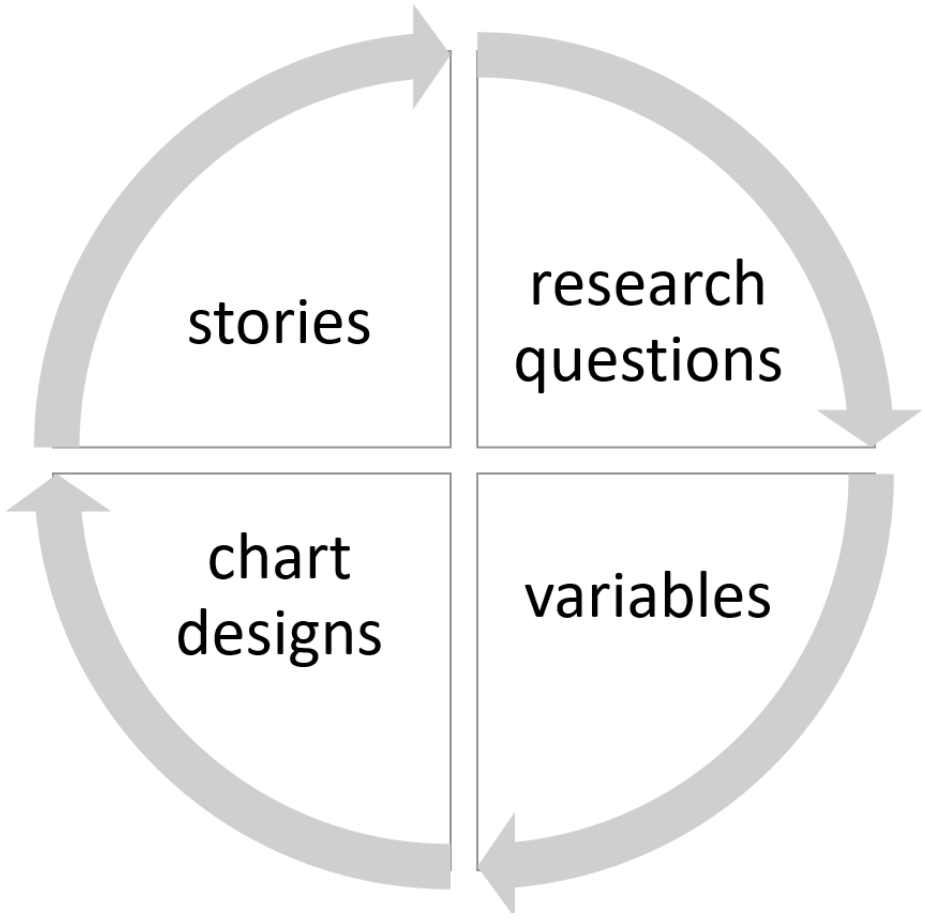
variable	type
path	categorical
years to graduate	quantitative

Combine a second category



variable	type
sex and path	categorical
years to graduate	quantitative

Discussion



Displaying distributions

What MIDFIELD distributions would you like to see:

- what quantitative variable?
- what categorical variables?

Closing discussion

Variables, design, message

For you, what was the muddiest point in the session?

Is there a graph design you would have liked to have seen today?

Is there a class of variables you would have liked to have seen today?