

Framed!

Reproducing 150 Year Old Charts

Susan VanderPlas
Ryan Gorluch
Heike Hofmann

IOWA STATE UNIVERSITY



STATISTICAL ATLAS
OF THE
UNITED STATES
BASED ON THE RESULTS OF THE
NINTH CENSUS 1870

WITH CONTRIBUTIONS FROM MANY EMINENT MEN OF SCIENCE
AND SEVERAL DEPARTMENTS OF THE GOVERNMENT.

COMPILED UNDER AUTHORITY OF CONGRESS
BY
FRANCIS A. WALKER, M.A.

SUPERINTENDENT OF THE 9TH CENSUS.

PROFESSOR OF POLITICAL ECONOMY AND HISTORY,
SHEFFIELD SCIENTIFIC SCHOOL OF YALE COLLEGE.

Slides

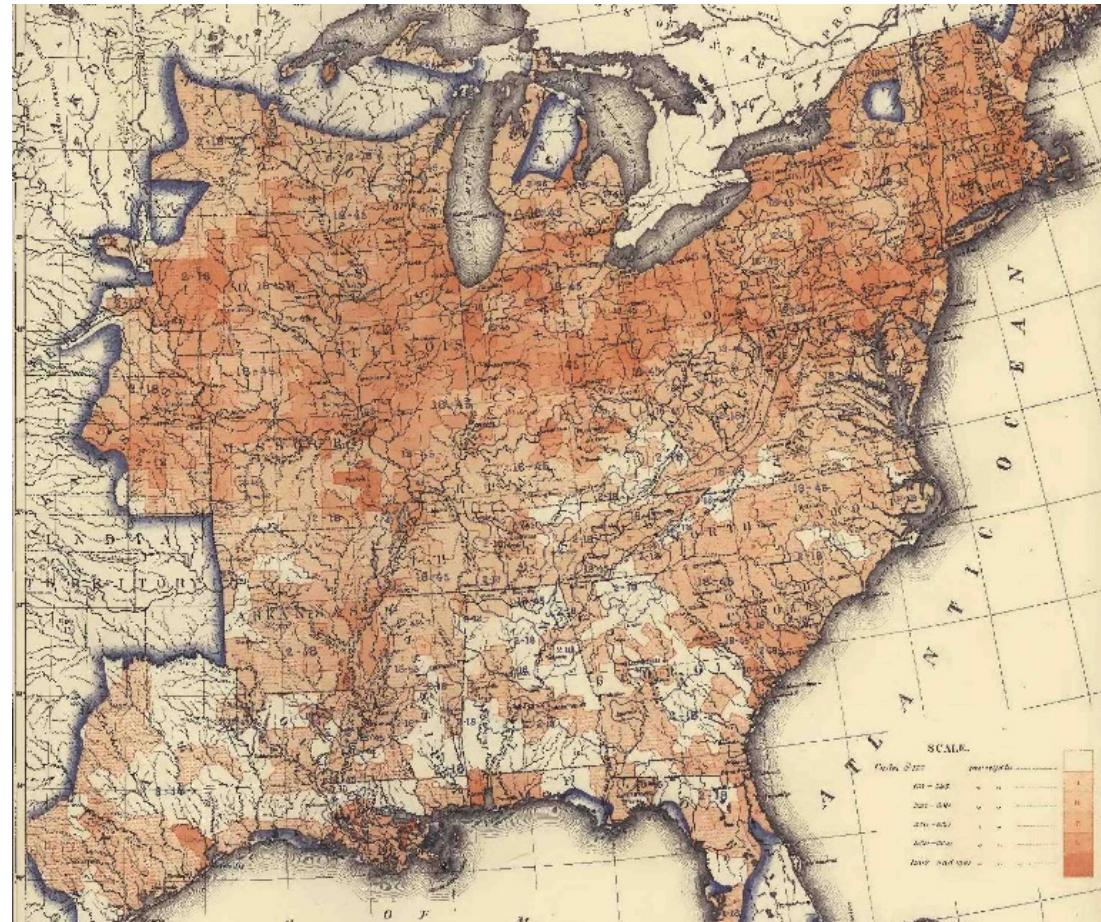
<http://rvanderplas.github.io/Presentations/JSM2018/Framed.html>

Project Repository

https://github.com/srvanderplas/Statistical_Atlas

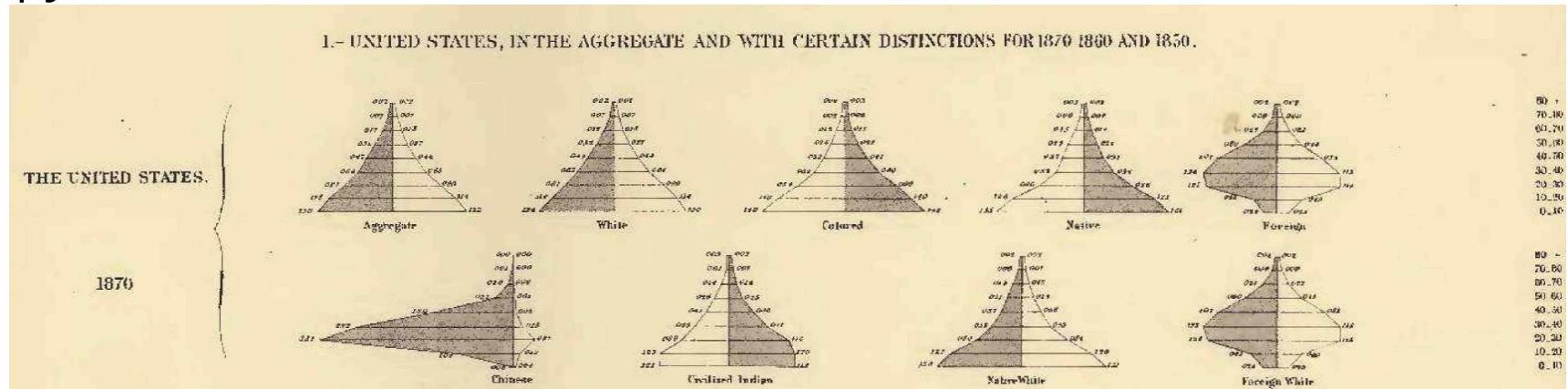
Introduction

- Statistical Atlas published for the 9th, 10th, and 11th census (1870, 1880, 1890)
- Charts created by hand and reproduced using lithography
- Goal: Show the composition of the country
 - Maps



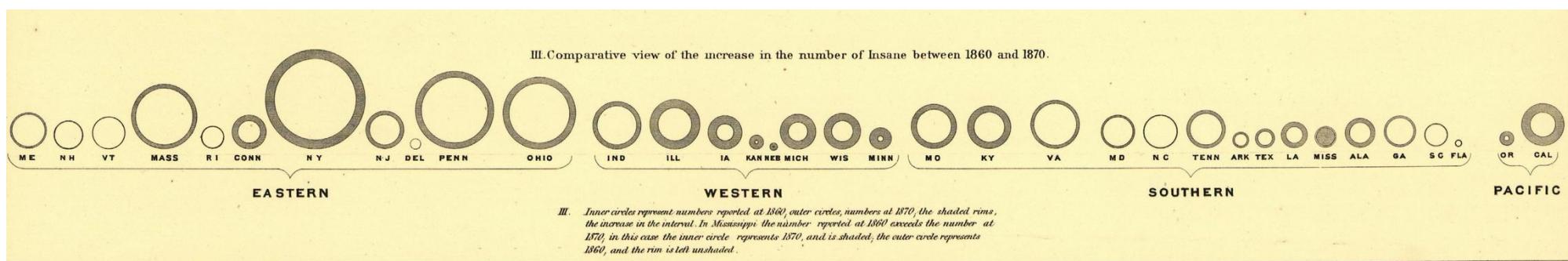
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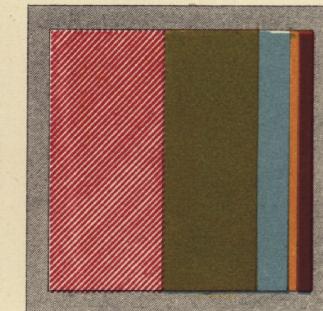


Introduction

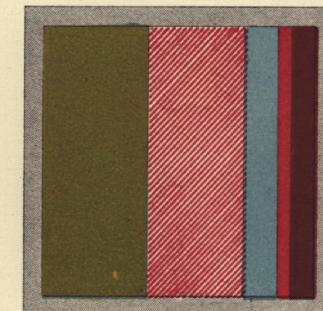
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 - framed mosaic and spine plots



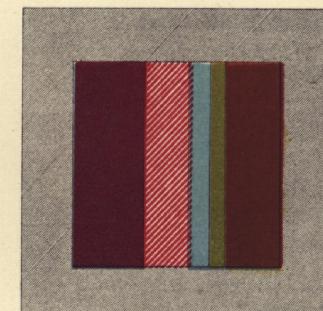
THE UNITED STATES



ALABAMA



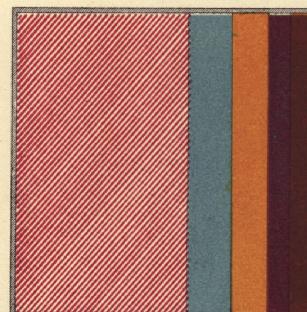
ARKANSAS



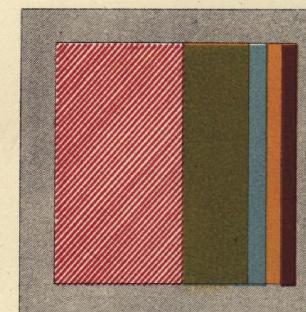
CALIFORNIA



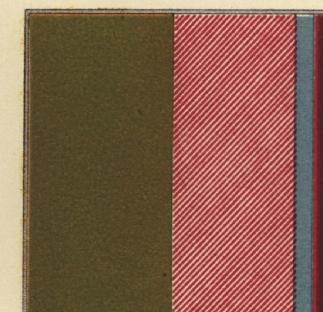
CONNECTICUT



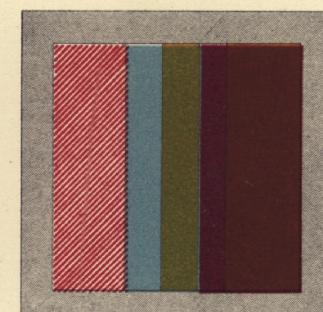
DELAWARE



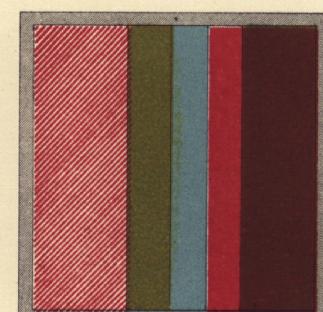
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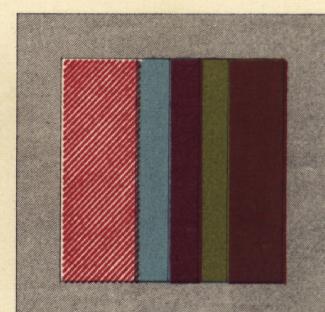
GEORGIA



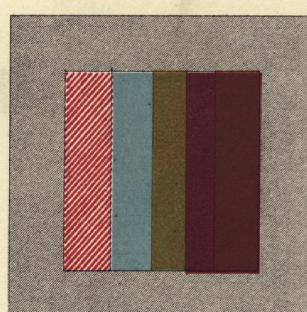
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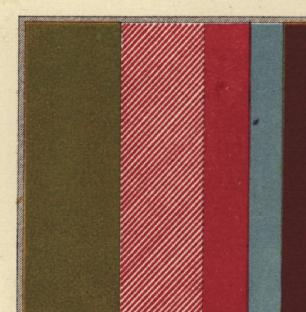
INDIANA



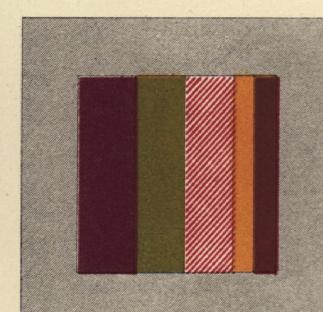
IOWA



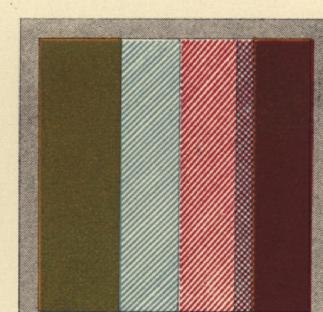
KANSAS



KENTUCKY



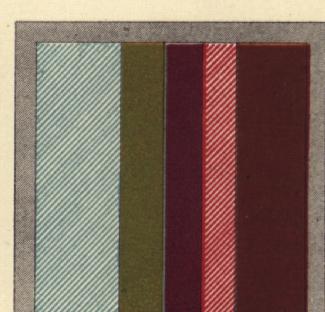
LOUISIANA



MAINE



MARYLAND



MASSACHUSETTS



CHART SHOWING THE RATIO OF CHURCH ACCOMMODATION

TO THE TOTAL POPULATION OVER 10 YEARS OF AGE

WITH THE PROPORTION OF SUCH CHURCH ACCOMMODATION FURNISHED BY EACH OF
THE LARGEST FOUR DENOMINATIONS WITHIN EACH STATE AND BY EACH OF
THE LARGEST EIGHT DENOMINATIONS WITHIN THE UNITED STATES.

Compiled from the Social Statistics of the Ninth Census 1870

BY
FRANCIS A.WALKER.

Note: The interior squares represent the proportion of the population which is provided for by the aggregate sittings in the churches of all denominations. The shaded interval between the inner and outer squares represents the population for which no church accommodation is provided. Where the aggregate church accommodation equals or exceeds the population over 10 years of age the shaded interval disappears.

Methodist	
Baptist	
Presbyterian	
Roman Catholic	
Congregational	
Episcopal	
Lutheran	
Christian	
Dutch Reformed	
Universalist	
Mormon	
All other Denominations	



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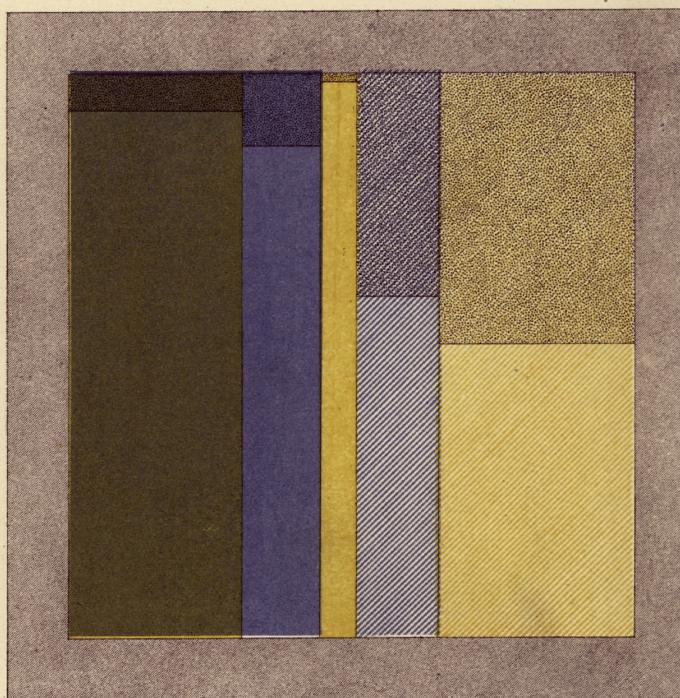
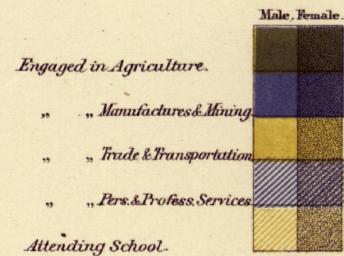


CHART
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 WITH DISTINCTION OF SEX, THE RATIO
 BETWEEN THE TOTAL POPULATION OVER 10 YEARS OF AGE
 AND THE NUMBER OF PERSONS REPORTED AS ENGAGED IN EACH PRINCIPAL CLASS OF

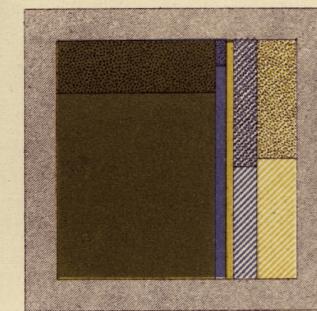
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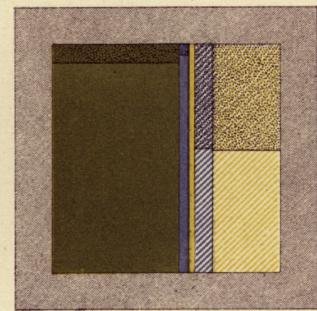
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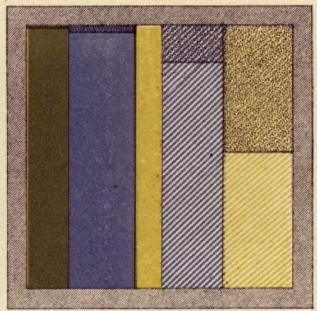
THE UNITED STATES



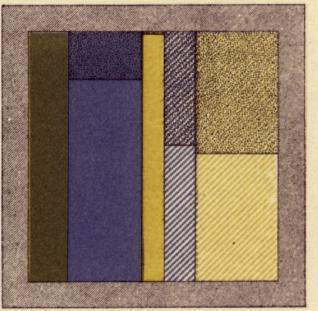
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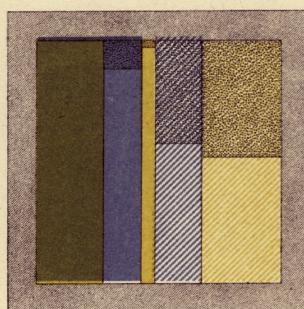
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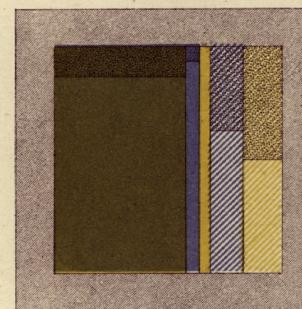
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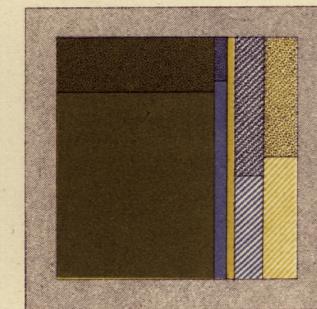
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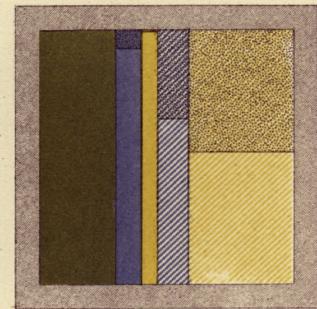
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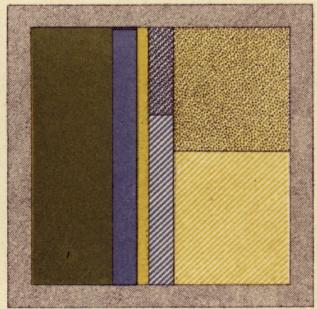
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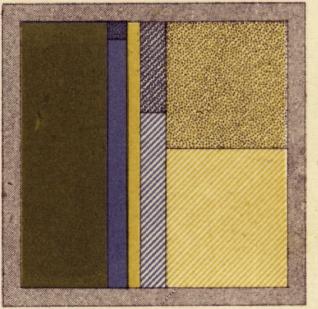
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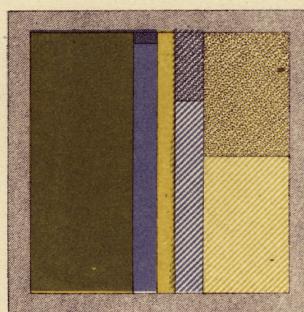
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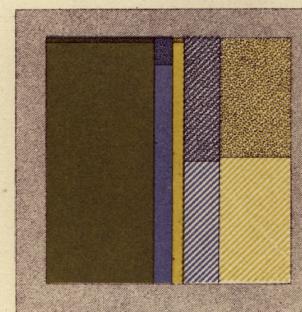
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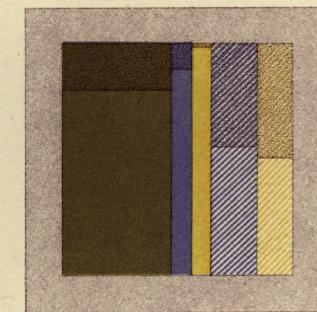
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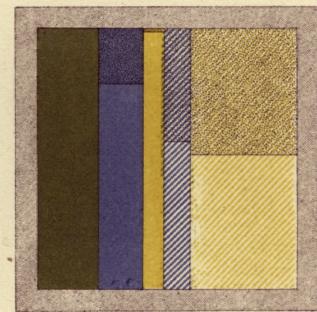
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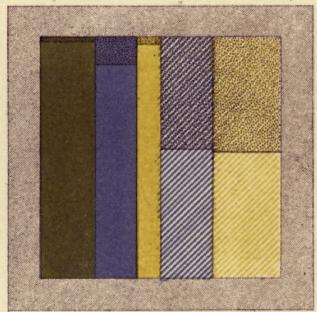
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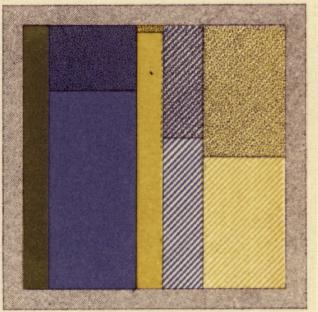
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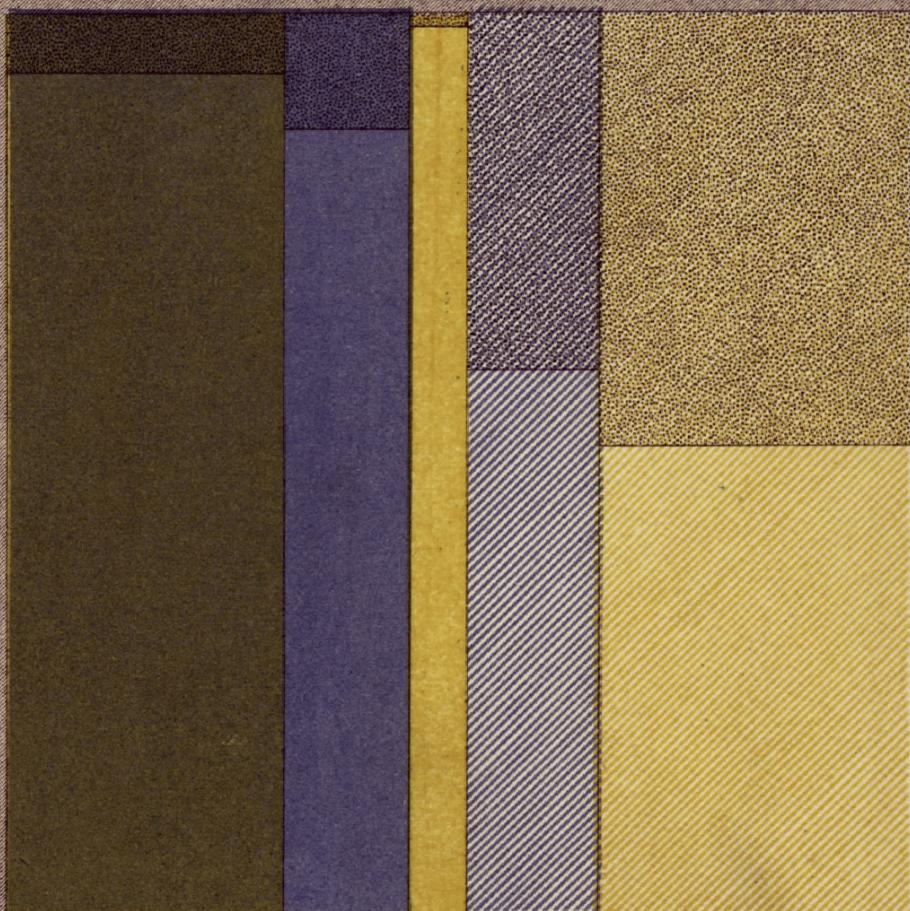


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Male, Female.

Engaged in Agriculture.

,, ,*Manufactures & Mining.*

,, ,*Trade & Transportation.*

,, ,*Pers. & Profess. Services.*

Attending School.



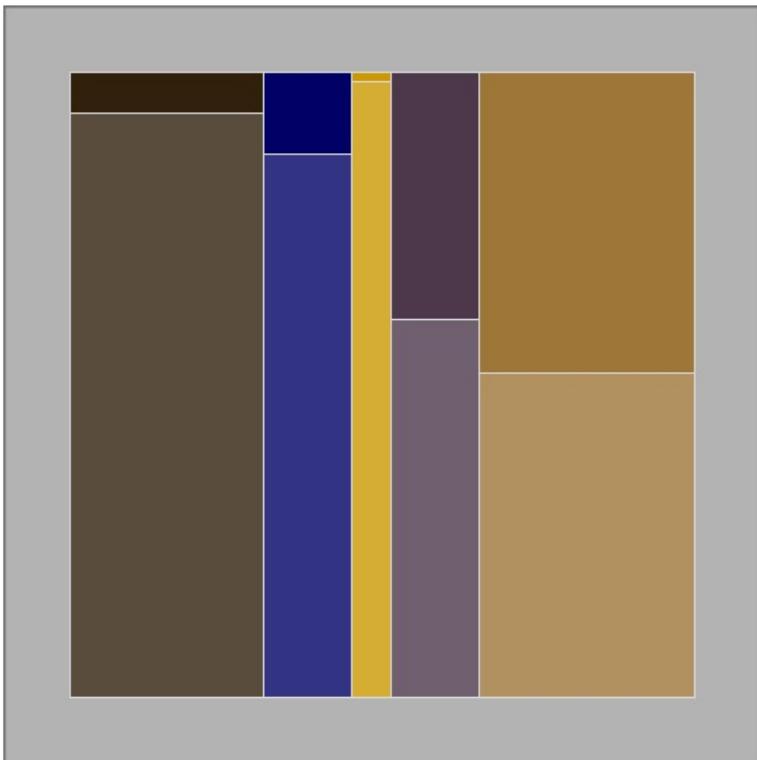
Statistical Archaeology

Reproduce the plots with modern methods

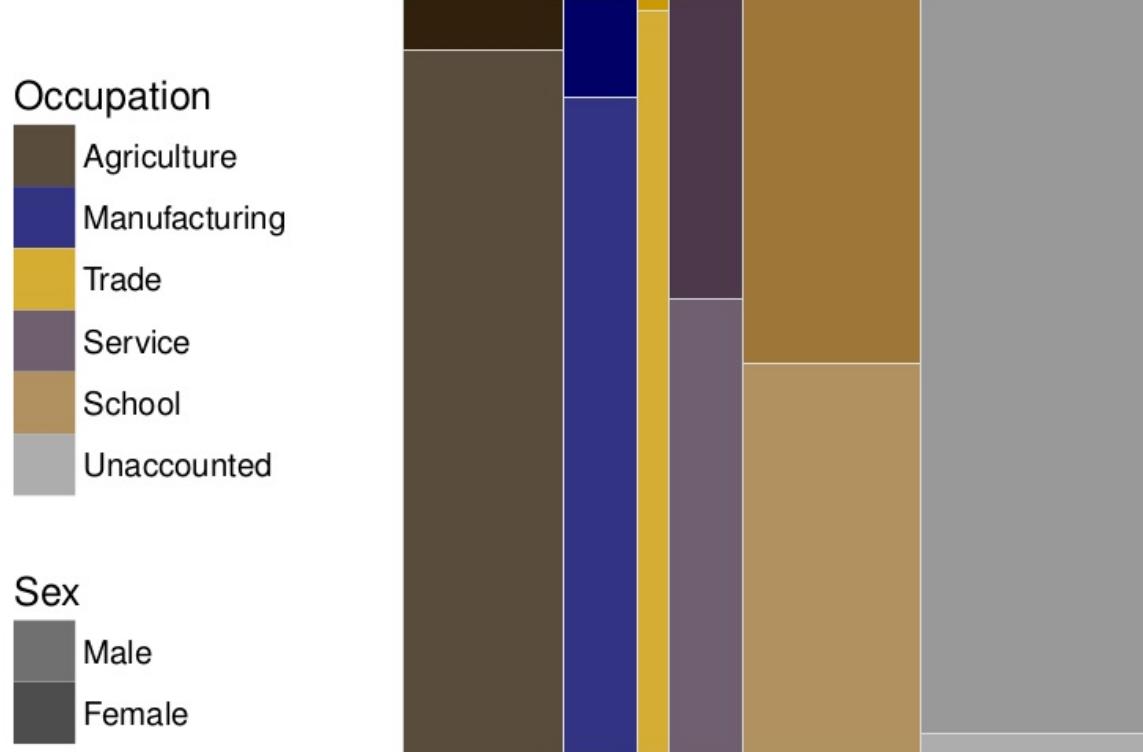
Data Sources:

- National Historical Geographic Information System
- Original 1870 Census tables
- Unaccommodated population estimates using 1% microsample data from Integrated Public Use Microdata Series (IPUMS).
- Pixel measurements (by hand) of the area of each chart (for comparison)

Occupation



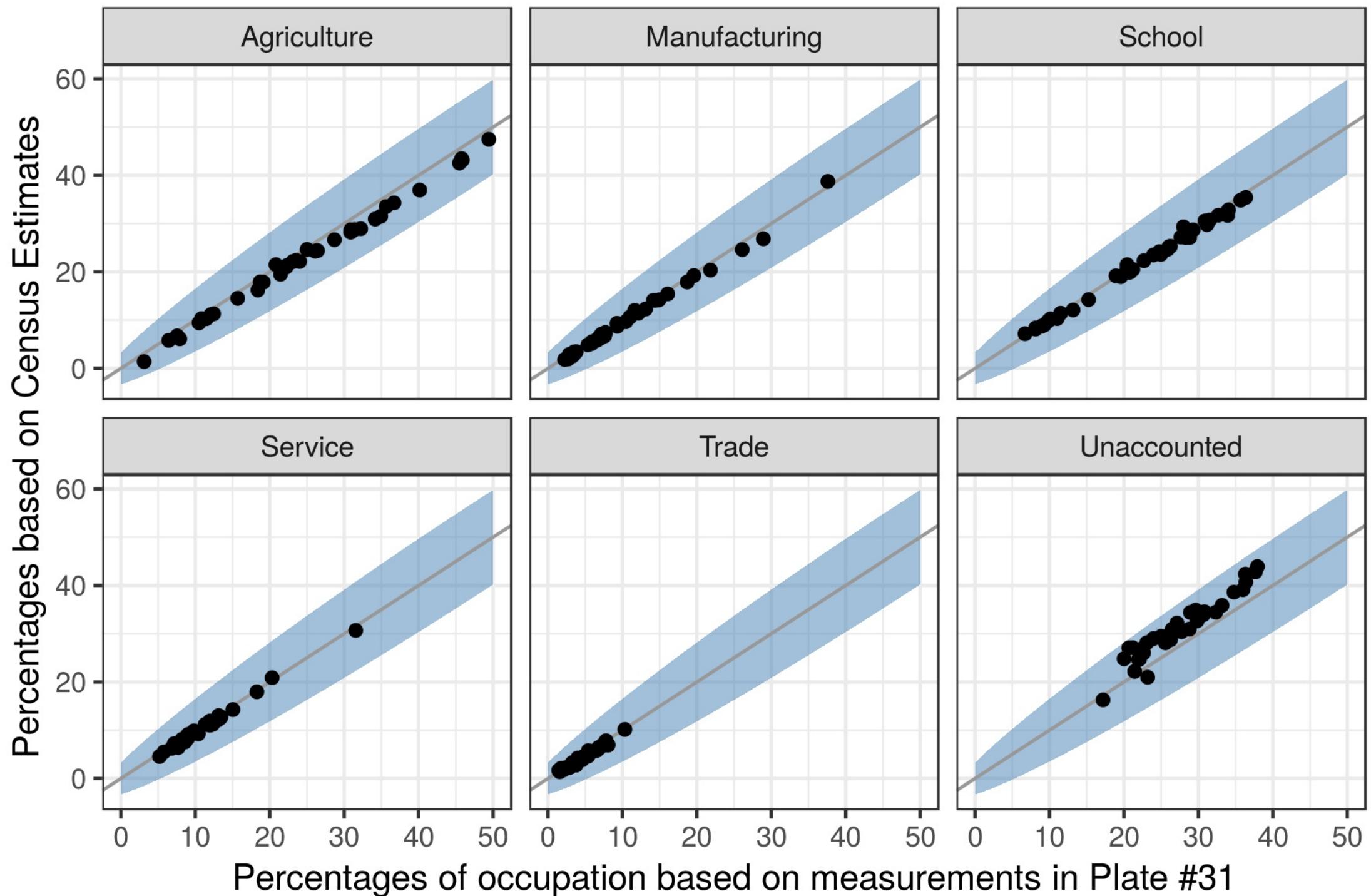
The United States



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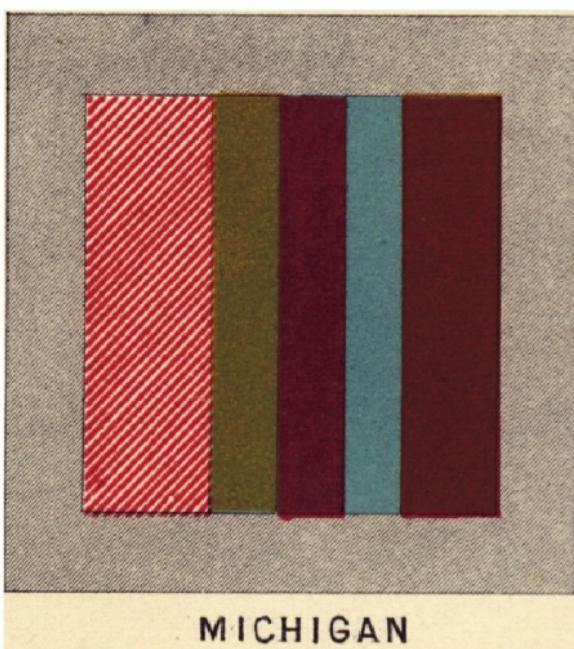
- Frame cuts the uncounted population into quarters visually
- No segmentation of the uncounted population - 97% of uncounted population is female

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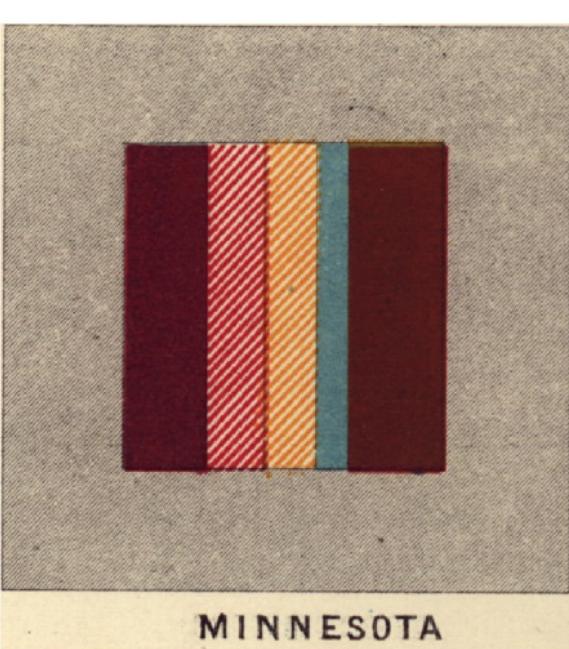


Church Accommodation

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MICHIGAN

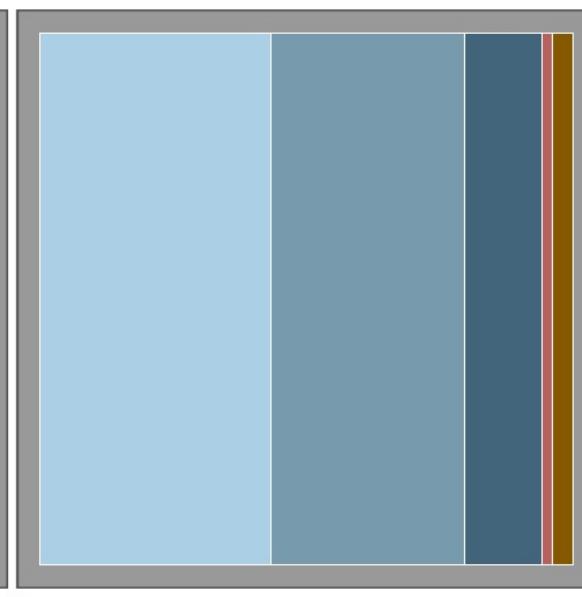
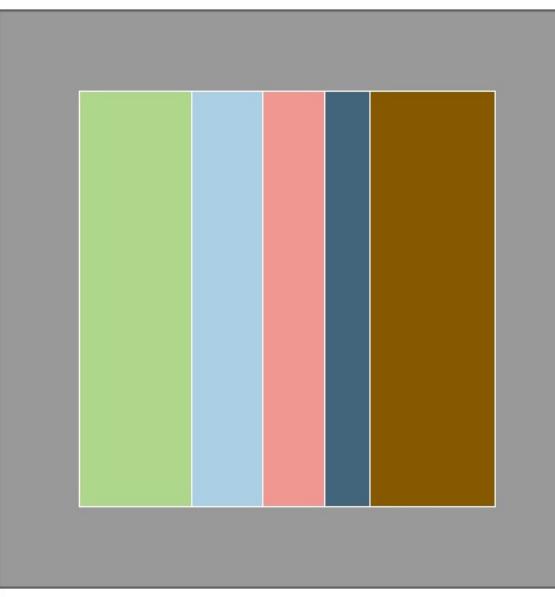
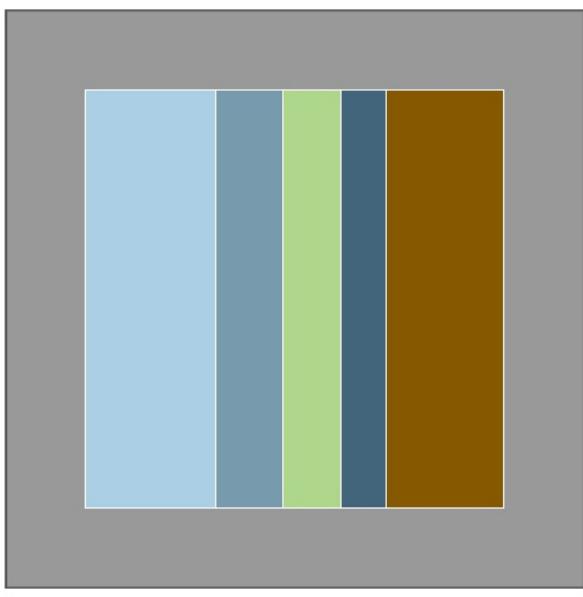
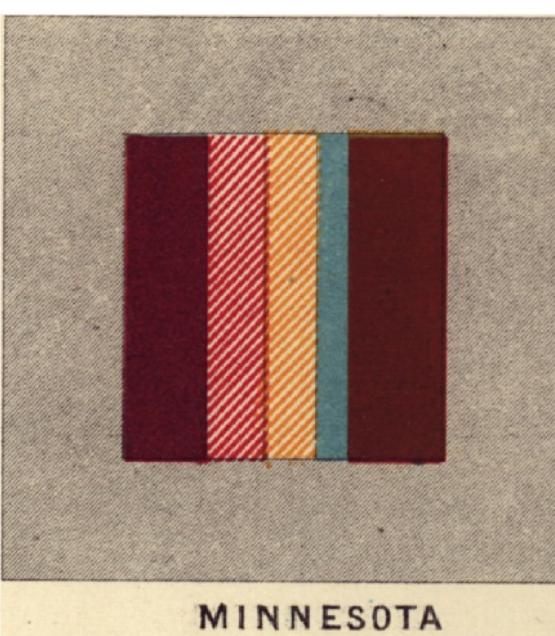


MINNESOTA

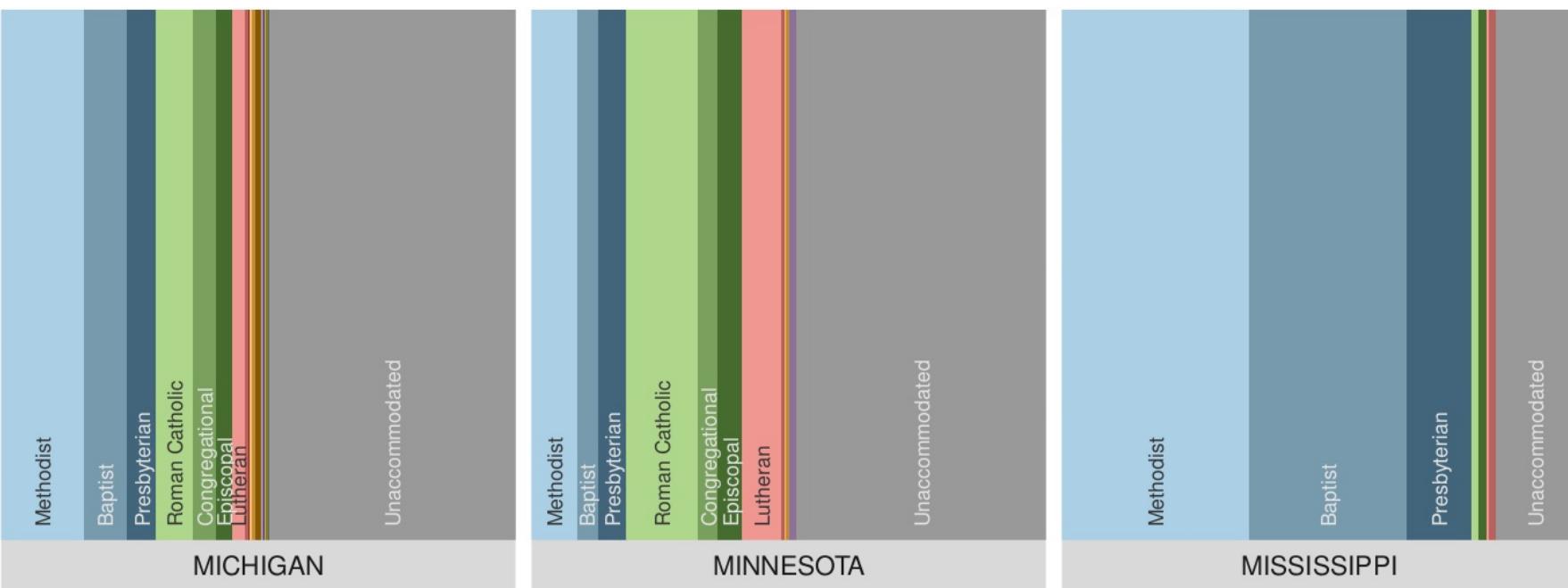
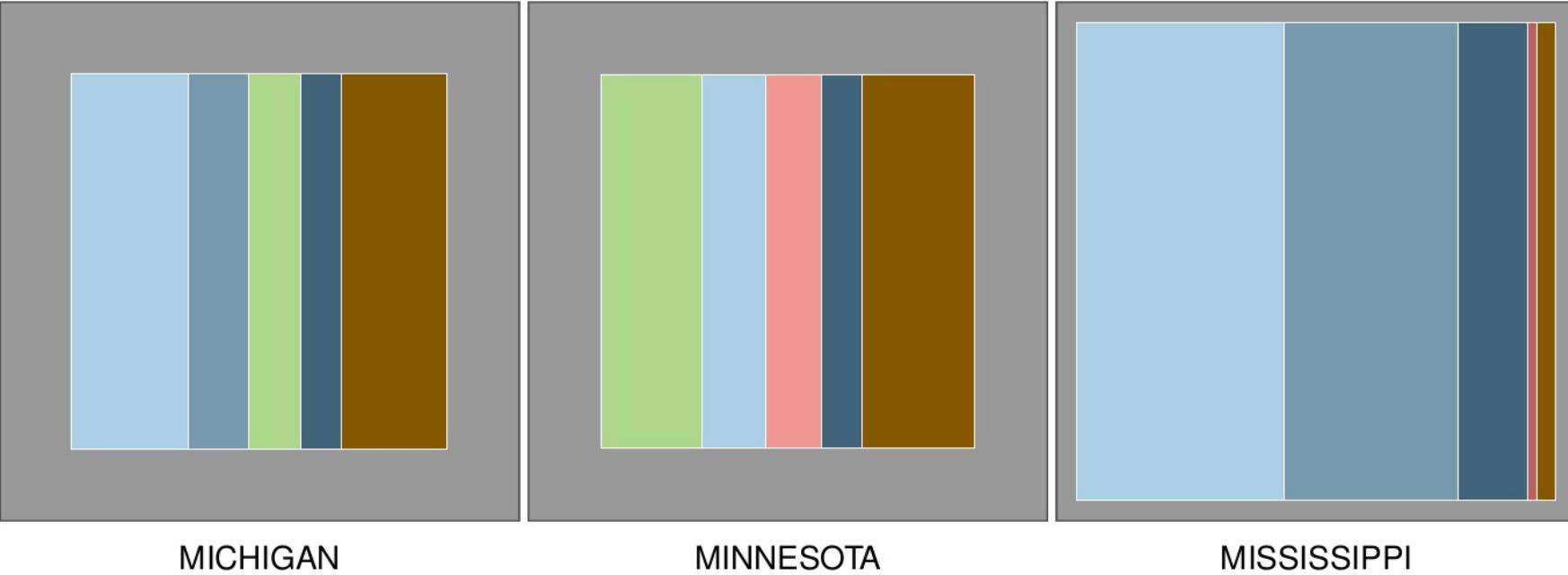


MISSISSIPPI

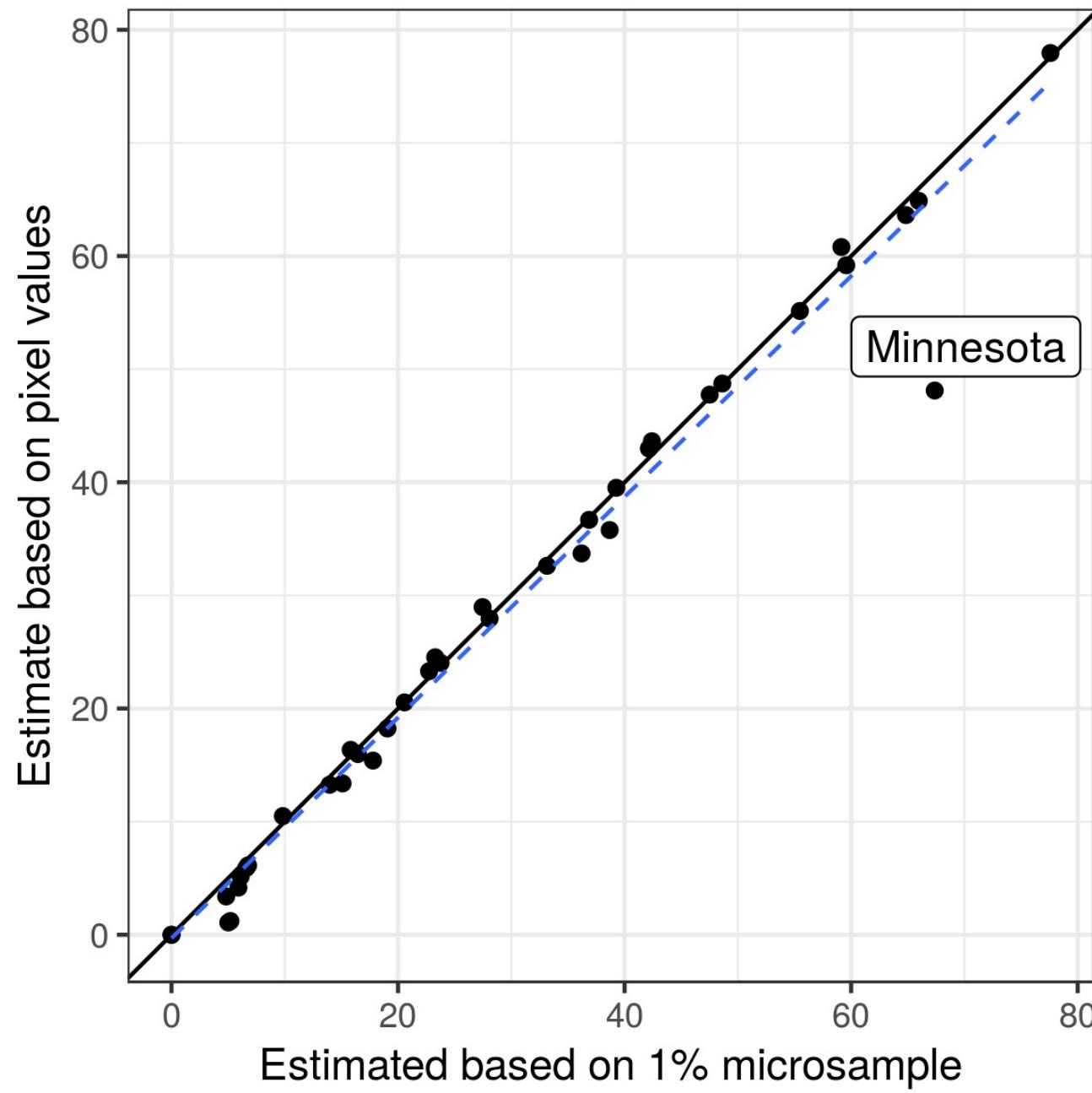
Church Accommodation



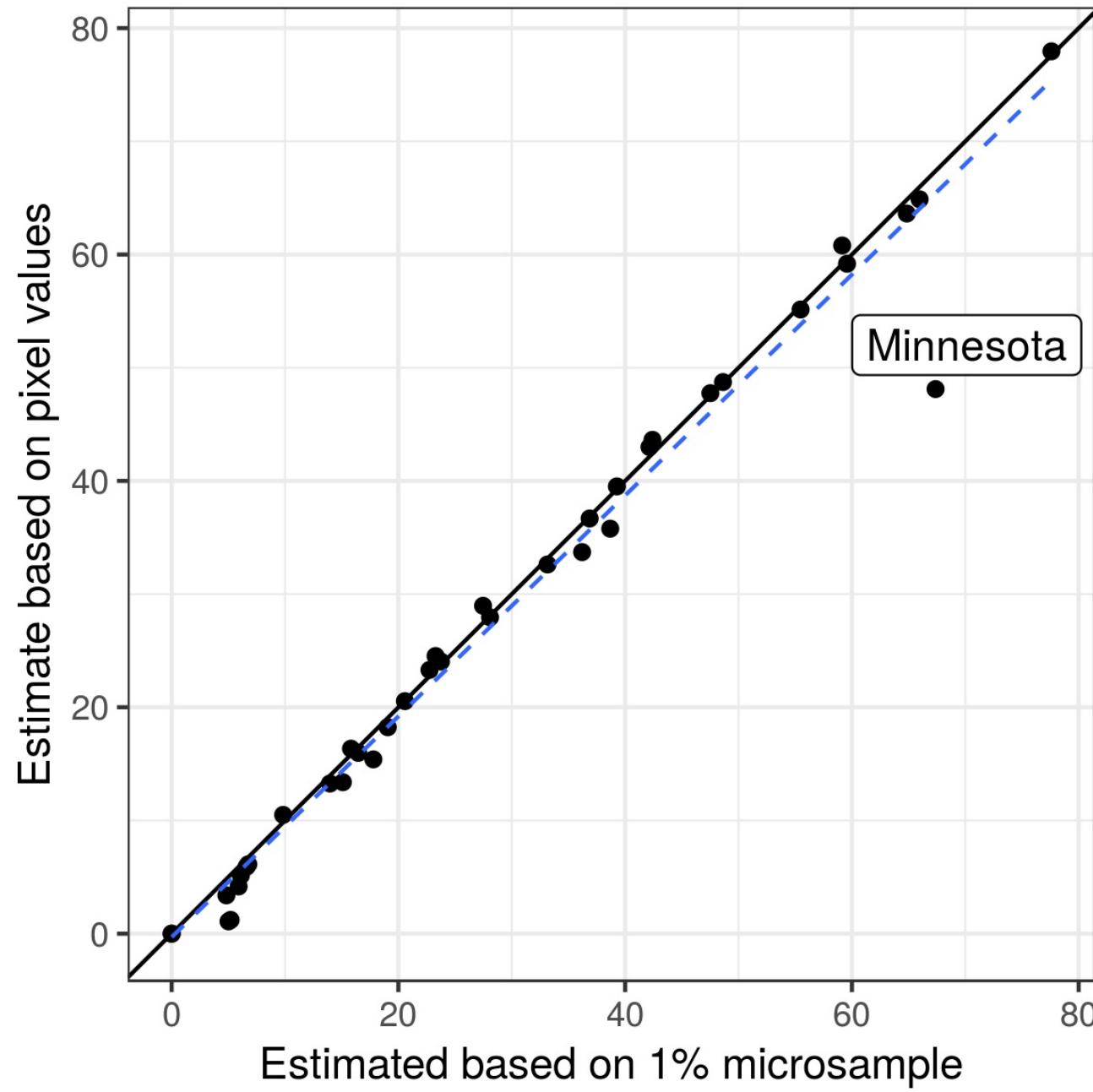
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Whoops. The lithographer screwed up.

Perception of Framed Plots

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- Estimation requires a two-stage process:
 1. Area of the main plot that is accommodated
 2. Area of the center region devoted to a specific category
- Primary comparisons are on the x-axis; the frame disrupts the ease of these comparisons

Frames in Practice

- 98 Participants (32 from reddit.com/r/samplesize, 63 from Amazon Mechanical Turk)

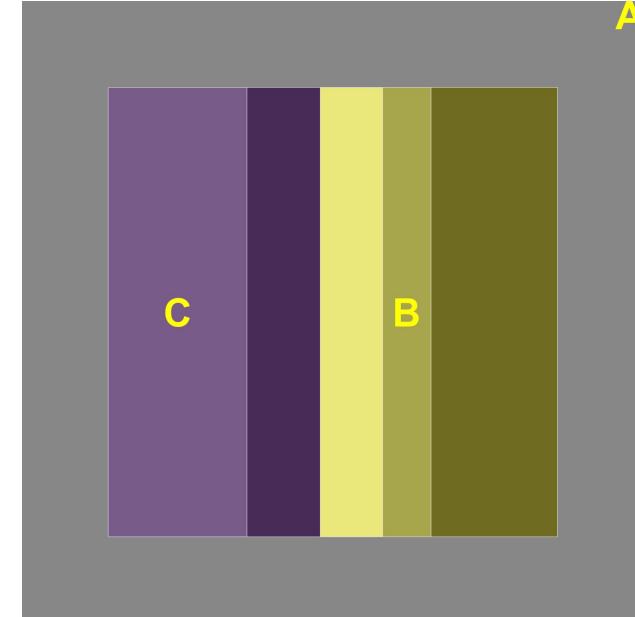
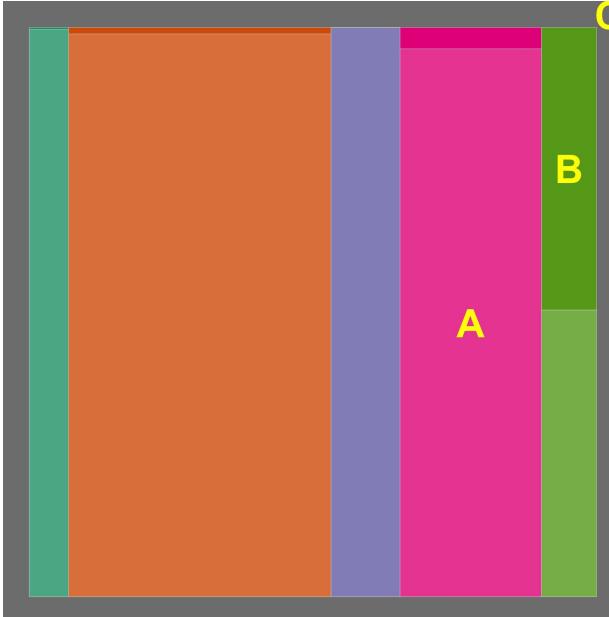
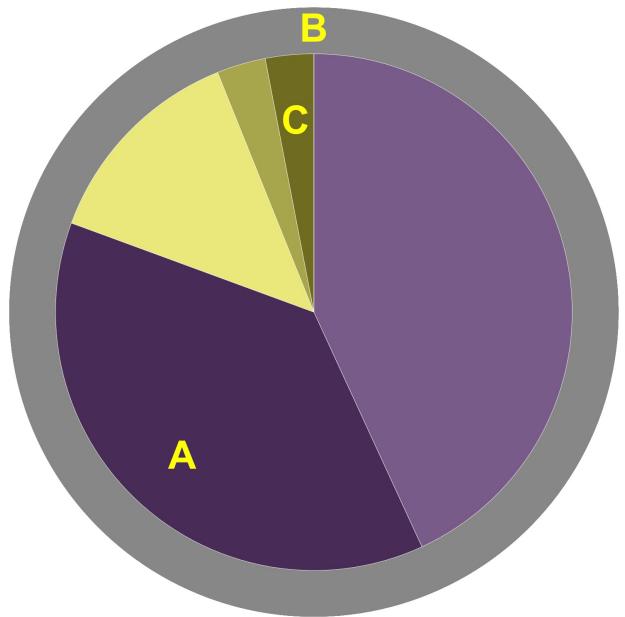
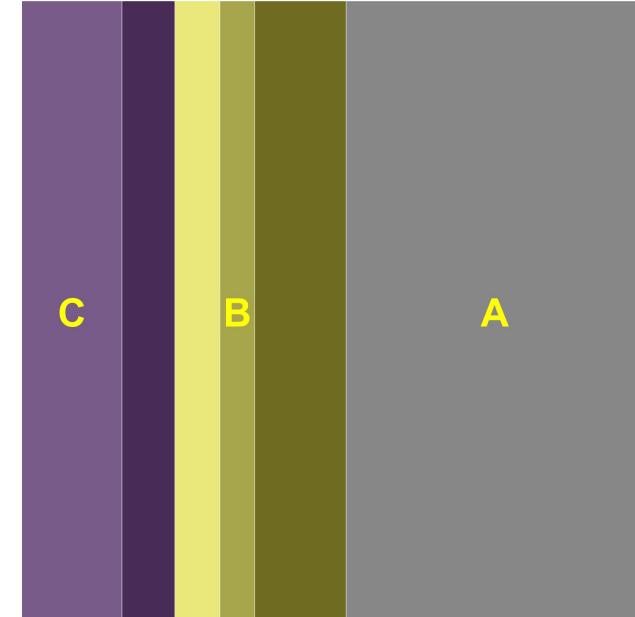
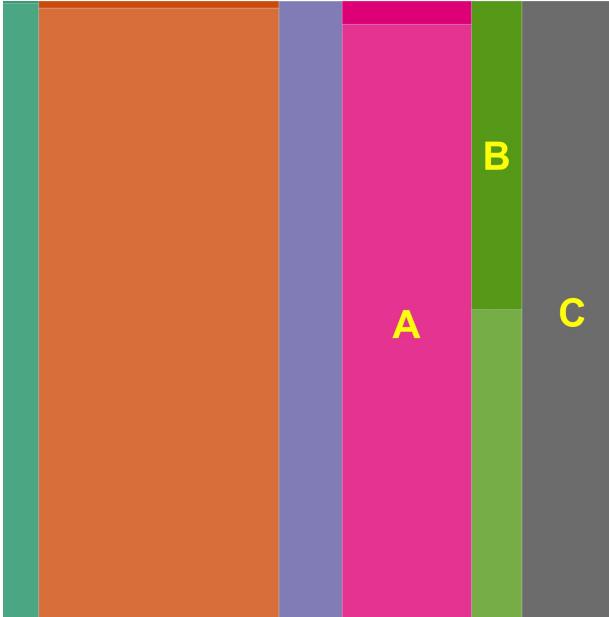
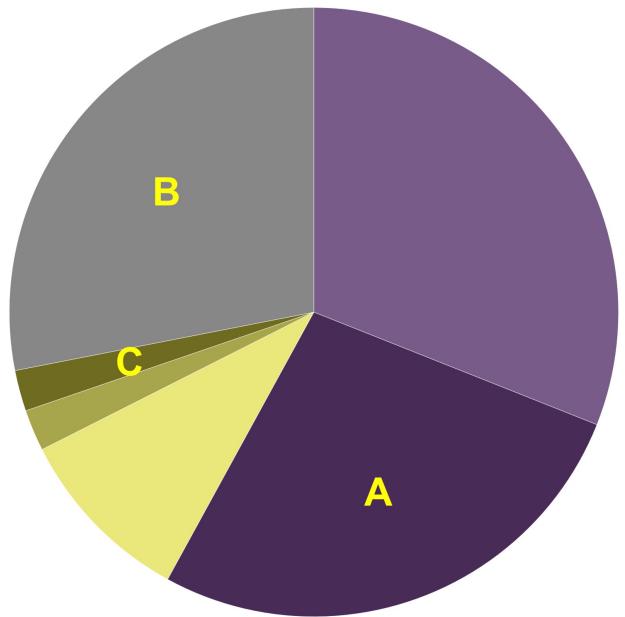
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- Each participant evaluated 18 plots
 - Region size: small, medium, large
 - Pie, Mosaic, Spine plots
 - Framed or Unframed charts

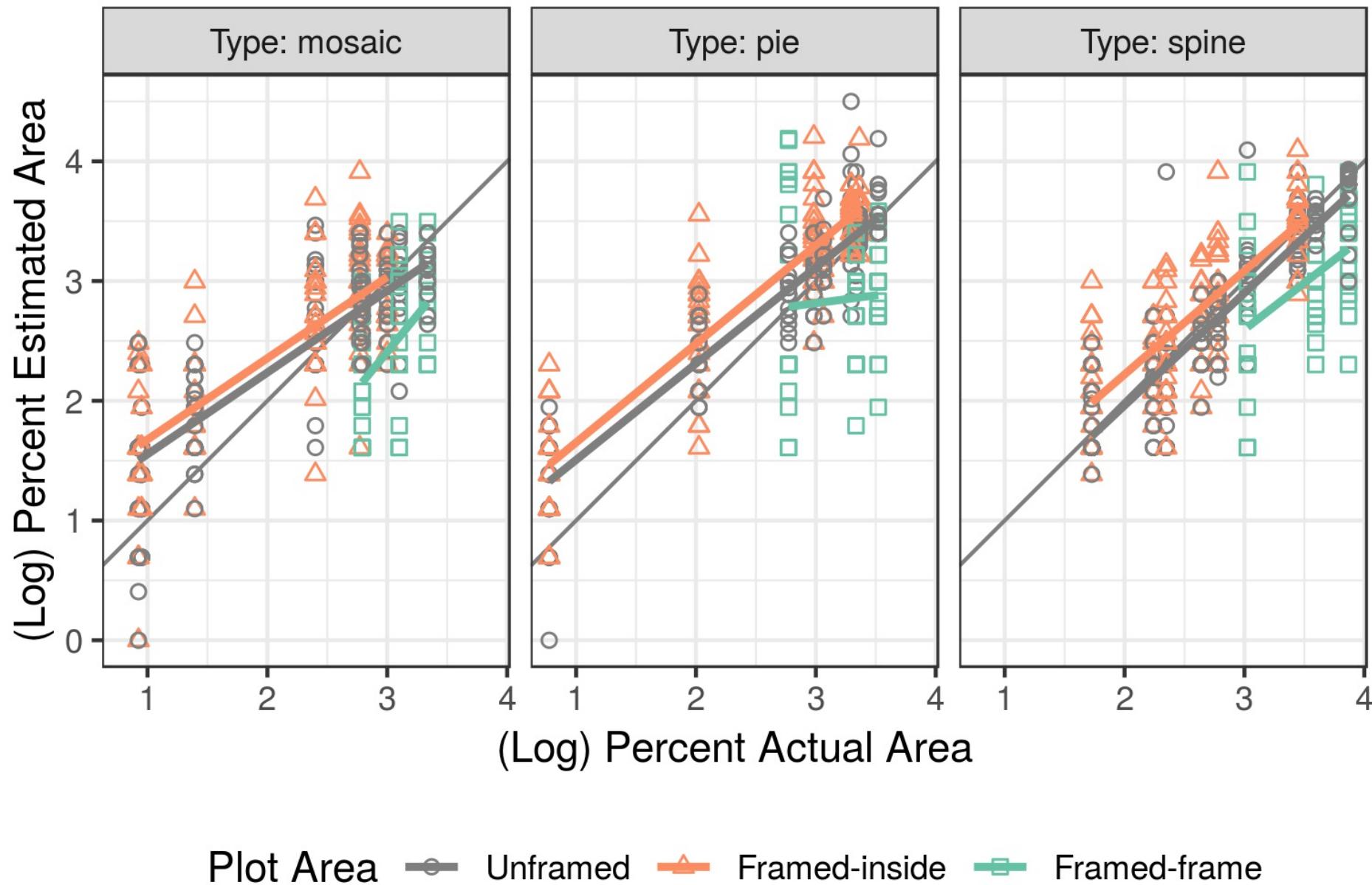
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- 25 seconds per plot

Frames in Practice



Results



Conclusions

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 - Pie charts largely replaced mosaic and spine plots

Conclusions

- Estimation of the framed portion of plots is significantly worse than the same area in an unframed plot
- Framed plots are not great for accurately communicating the data
 - They don't appear in the 1880 or 1890 census
 - Pie charts largely replaced mosaic and spine plots
- The Census Bureau and associated institutions did a great job of preserving the data necessary to reproduce the results and identify flaws in the analysis process

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150 years later, we can use completely different technology to get the same charts

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How's that for reproducibility?