Understanding the Benefits and Barriers of Undergraduate Research in Statistics

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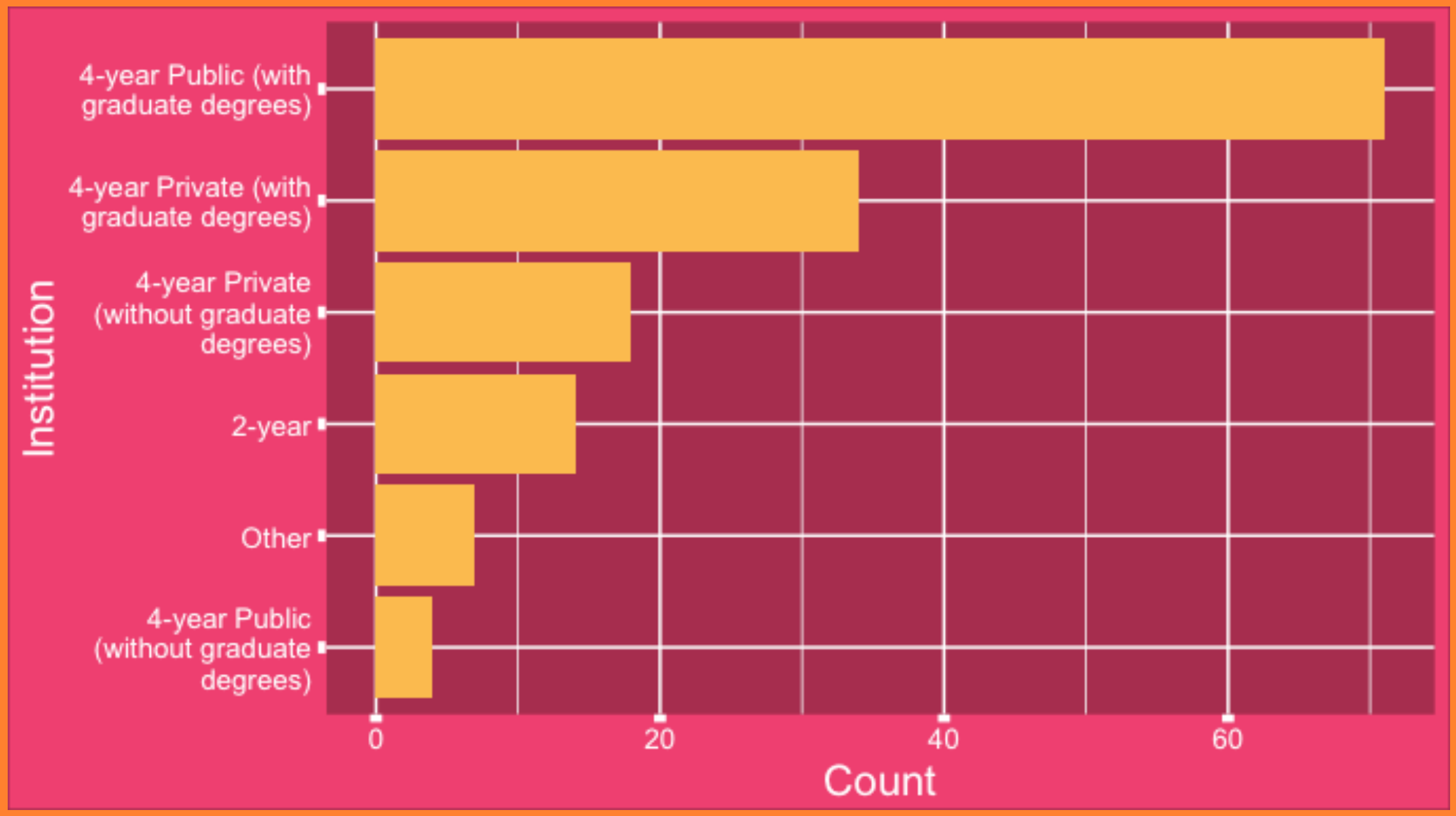
Undergraduate Research (UR) in Statistics Survey

- **Objective: Explore UR trends in terms of benefits, barriers, and incentives across different institutions and positions.**
- In summer of 2017, sent out survey to
  - ASA Section on Statistical Education Community.
  - Consortium on the Advancement of Undergraduate Statistics Education (CAUSE) listserv.
- Received 148 responses.
- Exploratory study.
  - Not generalizable to all statistical educators and institutions.

Undergraduate Research (UR) in Statistics Survey

- Collected information on:
  - Academic position
  - Institution
  - Statistical and data science offerings
  - Participation in UR
  - Perceived benefits and barriers
  - Student and faculty incentives
  - Research outcomes

Institutional Information

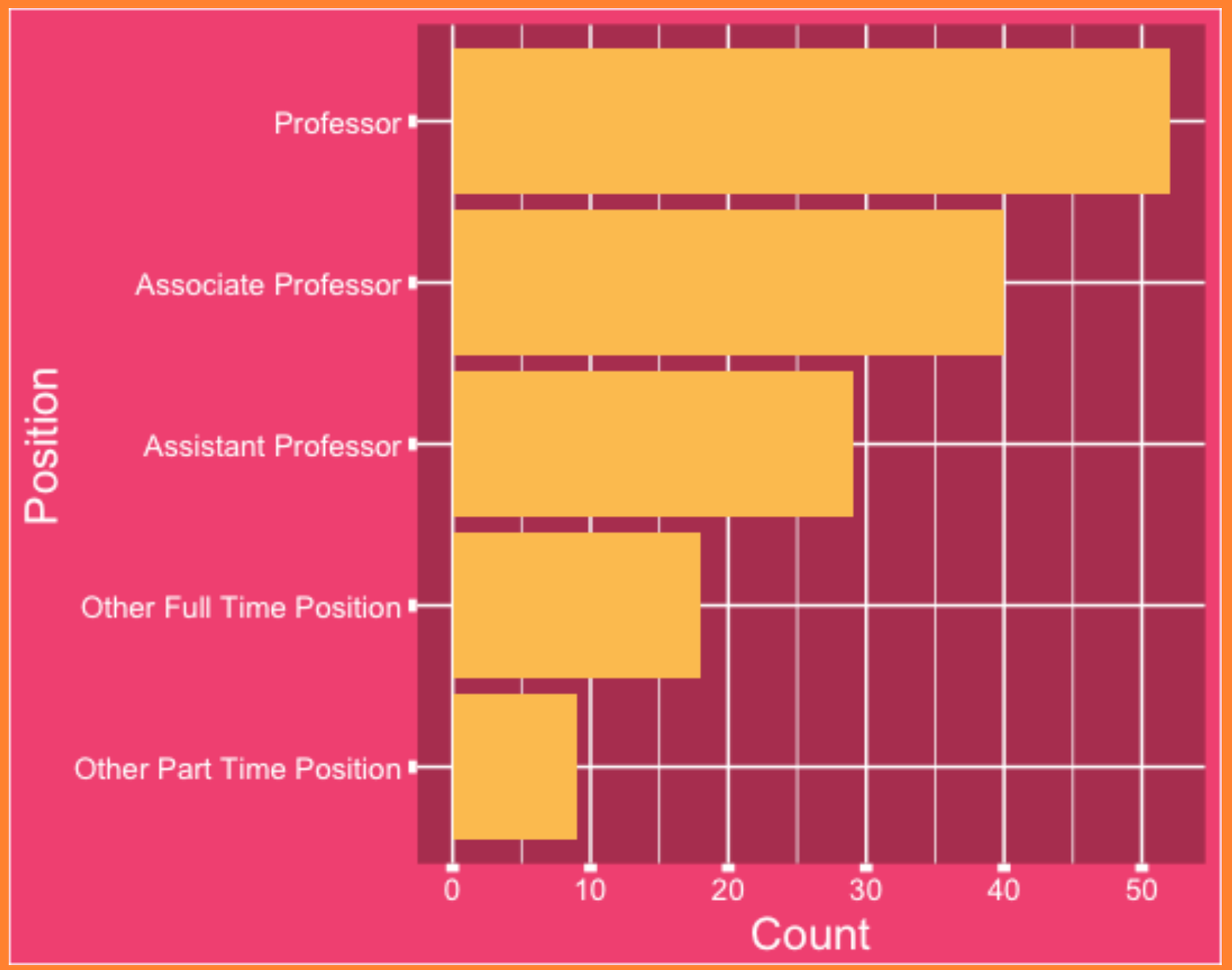


Institutional Information

- Major in statistics or data science is more common at public institutions with graduate degrees.
- Minor is common at the four year schools.

Institution	Major in Statistics or Data Science	Minor in Statistics or Data Science
4-year Public (with graduate degrees)	0.59	0.71
4-year Private (with graduate degrees)	0.38	0.56
4-year Private (without graduate degrees)	0.39	0.72
2-year	0.00	0.00
Other	0.29	0.57
4-year Public (without graduate degrees)	0.50	1.00

Faculty Demographics



Defining Undergraduate Research (UR) in Statistics

- We defined UR in statistics to include undergraduate students conducting research projects that are statistically related (either methodological or applied).
  - Examples: summer research, capstones, independent studies
- Distinguished UR from class projects

Faculty Involvement in UR

- What activities have you been involved in?
  - Likely have serious response bias here.
  - But a few observations for this data:
    - Most of the 4-year private (without graduate degrees) faculty in survey participated in UR and use projects in classroom.
    - Less involvement from the 2-year faculty though include projects in classroom.

Institution	No Involvement	Mentored UR	Projects in Stat1	Projects in Stat2
4-year Public (with graduate degrees)	0.20	0.58	0.52	0.44
4-year Private (with graduate degrees)	0.18	0.50	0.53	0.53
4-year Private (without graduate degrees)	0.00	1.00	0.89	0.94
2-year	0.43	0.21	0.50	0.07

Faculty Involvement in UR

- What activities have you been involved in?
  - Numbers similar across tenure track ranks but lower for non-tenure track positions.

Position	No Involvement	Mentored UR	Projects in Stat1	Projects in Stat2
Professor	0.12	0.69	0.65	0.60
Associate Professor	0.22	0.60	0.52	0.48
Assistant Professor	0.14	0.59	0.52	0.48
Other Full Time Position	0.33	0.28	0.44	0.28
Other Part Time Position	0.44	0.22	0.56	0.00

Faculty Involvement in UR

- For faculty who have mentored UR…
  - What type of UR students have you mentored?

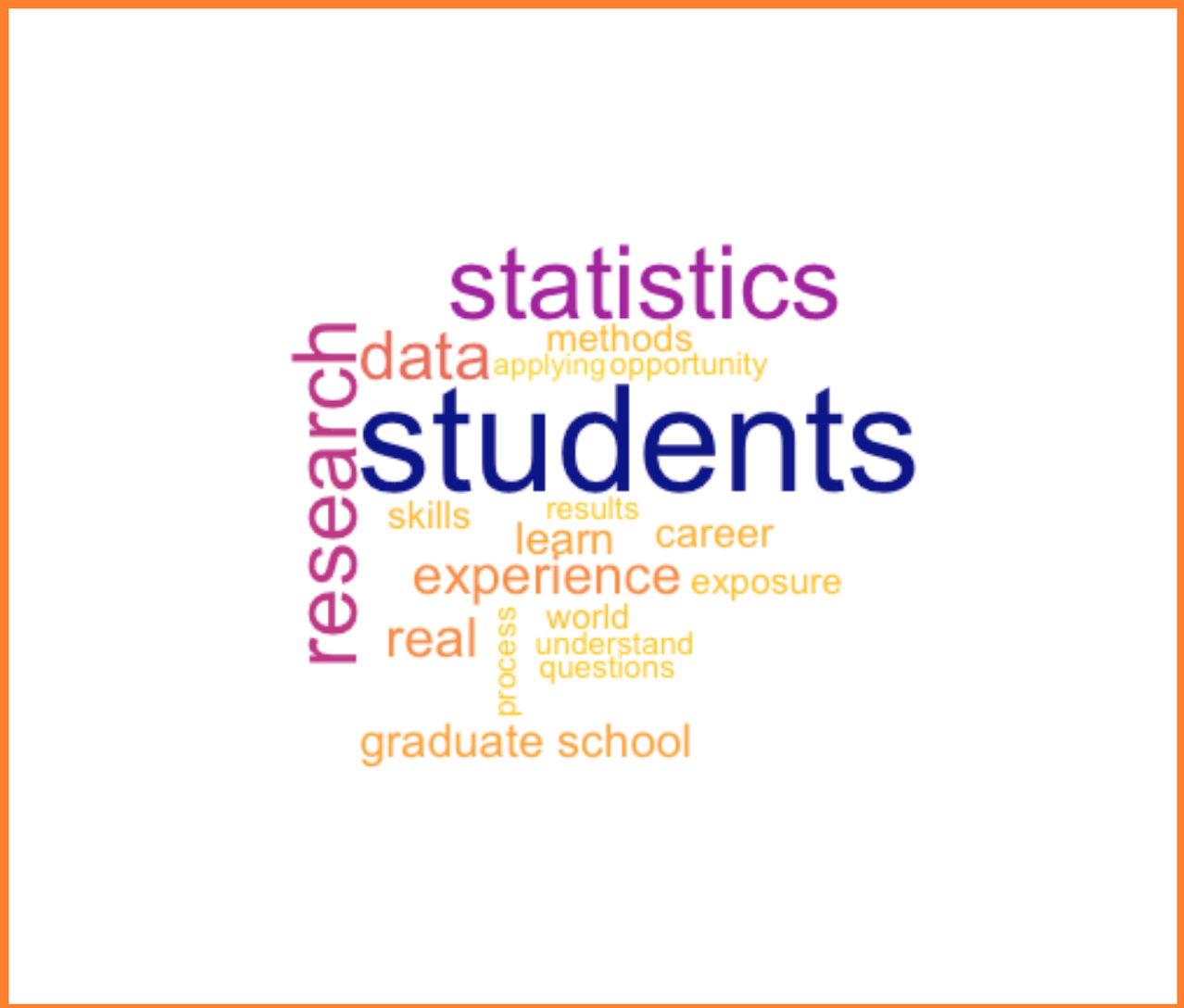
Position	Mentored upperclassmen	Mentored underclassmen
Professor	0.94	0.46
Associate Professor	0.86	0.36
Assistant Professor	0.94	0.62
Other Full Time Position	0.80	0.20
Other Part Time Position	0.50	1.00

  - When have you mentored UR?

Position	Summer	Regular semesters	Classroom
Professor	0.57	0.77	0.57
Associate Professor	0.45	0.73	0.36
Assistant Professor	0.75	0.69	0.25
Other Full Time Position	0.60	0.40	0.60
Other Part Time Position	0.50	0.50	0.50

What do you see as the most important benefit(s) of UR in Statistics?

- Almost all of the free text answers addressed the perceived benefits for the **students**, not for the faculty.
  - 63% of answers included the word “student(s)”



What do you see as the most important benefit(s) of UR in Statistics?

- Student themes
  - **Supports or enhances the student's education**
    - "Learning by doing"/See how statistics is REALLY done
    - Improve skills (computational, problem-solving, writing, communication)
    - Experience handling **real**, **messy** data and **open-ended** problems
    - Draw connections between coursework and statistics in practice
    - Exposure to statistical topics beyond usual curriculum
    - Gain a deeper understanding of a particular topic

What do you see as the most important benefit(s) of UR in Statistics?

- Student themes
  - **Builds student appreciation for statistics**
    - See applicability and relevance of statistics to many fields
    - Exposure to the breadth and depth of statistics
    - Encourages students to study more statistics or become a statistician

What do you see as the most important benefit(s) of UR in Statistics?

- Student themes
  - **Provides professional preparation**
    - Strengthens graduate school application and employment prospects
    - Provides apprenticeship experience through 1-1 mentoring
    - Exposes students to future career paths
    - Clarifies students' career choices

What do you see as the most important benefit(s) of UR in Statistics?

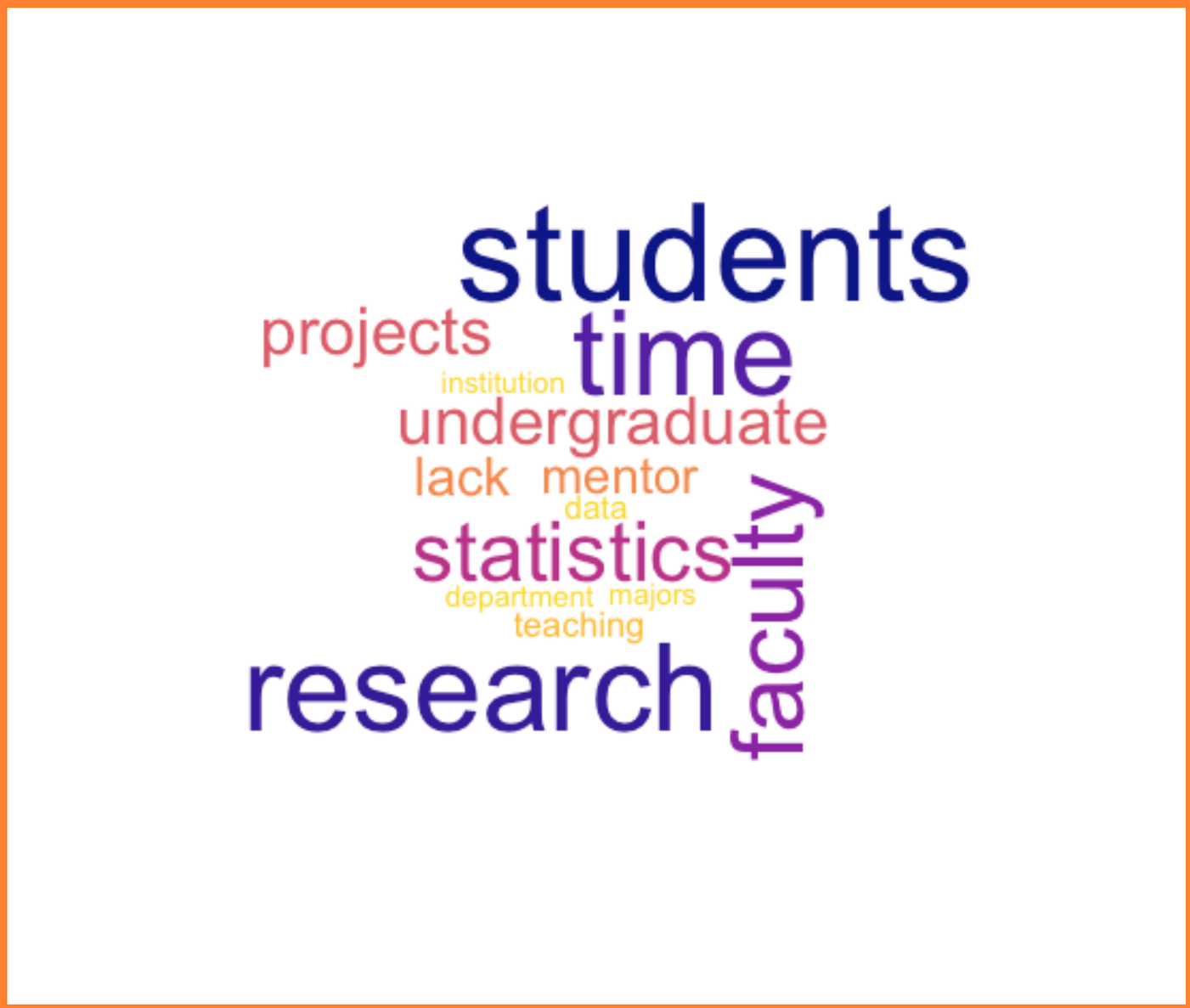
- Student themes
  - **Facilitates personal development**
    - Provides opportunity to develop **persistence** and **resilience** by overcoming issues in the statistical process
    - Gives students **confidence** in their statistical and non-statistical abilities
    - Increases student engagement
    - Develops students' communication skills

What do you see as the most important benefit(s) of UR in Statistics?

- Faculty themes
  - **Gives faculty research support**
  - **Provides opportunity to mentor undergraduates in research**

What do you see as the most important barrier(s) to UR in Statistics at your institution?

- Many mention a high demand from students and that their department can only meet a fraction of the demand.
  - Over half of answers contained the word “time”.



What do you see as the most important barrier(s) to UR in Statistics at your institution?

- Faculty themes
  - **Not part of the faculty's already overloaded "day job"**
    - Lack of time
    - Lack of sufficient incentives
    - Lack of reward/recognition
    - Lack mentoring skills

What do you see as the most important barrier(s) to UR in Statistics at your institution?

- Faculty themes
  - **Potential negative impact on faculty's research agenda**
    - May not result in peer-reviewed manuscript
    - Slows down productivity
    - Difficult to align with faculty research agenda
    - Return on time investment is not substantial

What do you see as the most important barrier(s) to UR in Statistics at your institution?

- Faculty themes
  - **Potential pitfalls**
    - Finding good projects and data
    - Appropriately matching student and faculty interests
    - Difficult to attract strong students

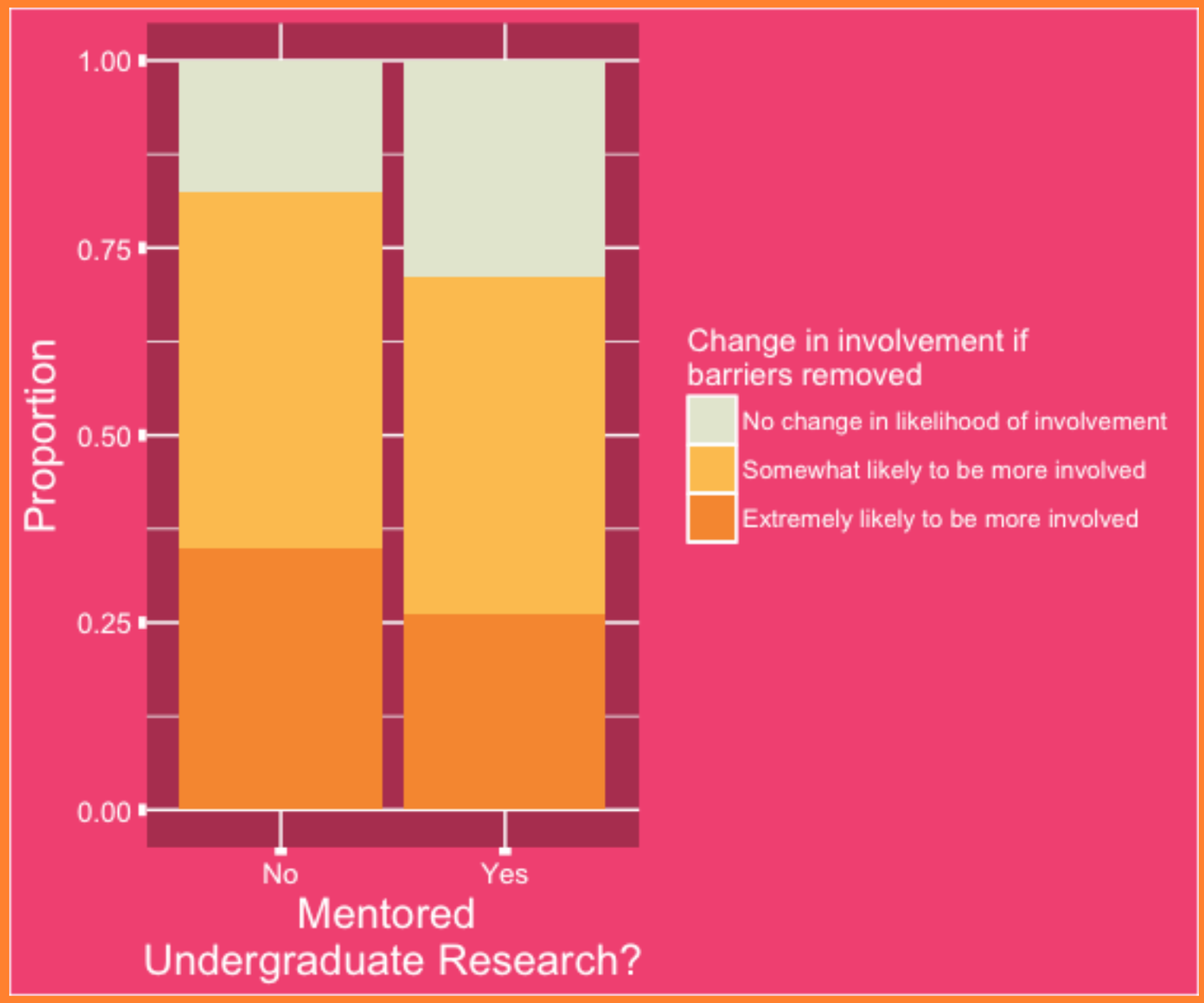
What do you see as the most important barrier(s) to UR in Statistics at your institution?

- Institutional theme
  - **Statistics program isn't robust enough to prepare students for statistics research**
    - Not enough faculty
    - Not enough students
    - Not enough courses beyond Stat1

What do you see as the most important barrier(s) to UR in Statistics at your institution?

- Student themes
  - **Lack time and financial resources to take extra courses or participate in research**
  - **Don’t see the value of UR for future employment**
  - **Lack necessary skills and sufficient background**

If the barriers you mentioned were removed, how might that change your involvement in UR in Statistics?



Overcoming barriers

- Several of the talks in this session will discuss how they, their department, and/or their institution have been able to overcome barriers.
- I want to focus on possible **incentives** and **outcomes** measured in the survey.

Which of the following outcomes have resulted from your mentoring UR in Statistics within the last five years?

- On-campus, and even off-campus, presentations are a very common outcome.
- Many report enhanced post-graduate opportunities.
- Several have had publication success, especially at the private institutions without graduate degrees.

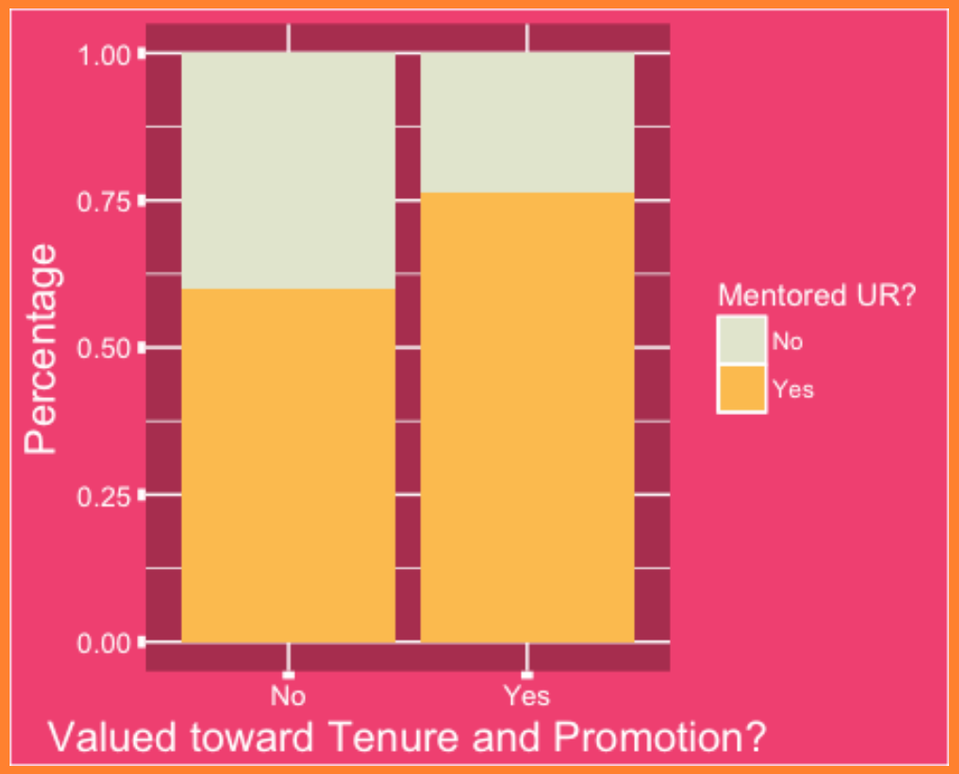
Institution	Publication	Publication in UR Journal	On-campus Presentation	Off-campus Presentation	Enhanced Opportunities
4-year Public (with graduate degrees)	0.24	0.11	0.74	0.53	0.45
4-year Private (with graduate degrees)	0.29	0.00	0.93	0.43	0.71
4-year Private (without graduate degrees)	0.53	0.12	0.94	0.76	0.76
2-year	0.00	0.00	1.00	0.00	0.00

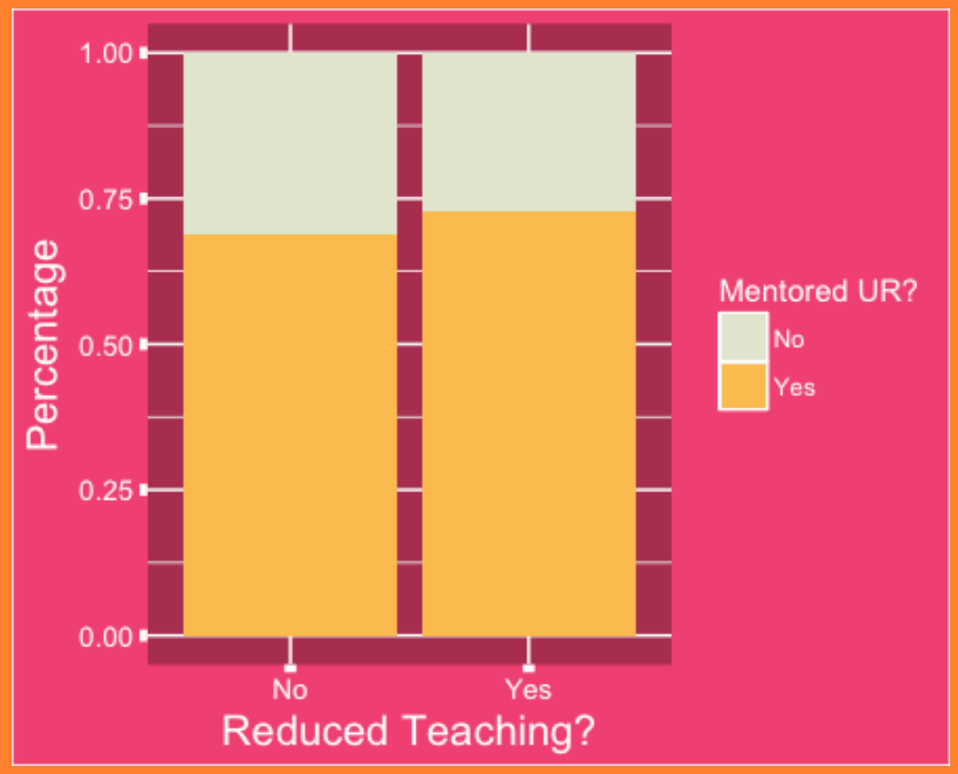
How does your school incentivize faculty to mentor UR as a part of their workload?

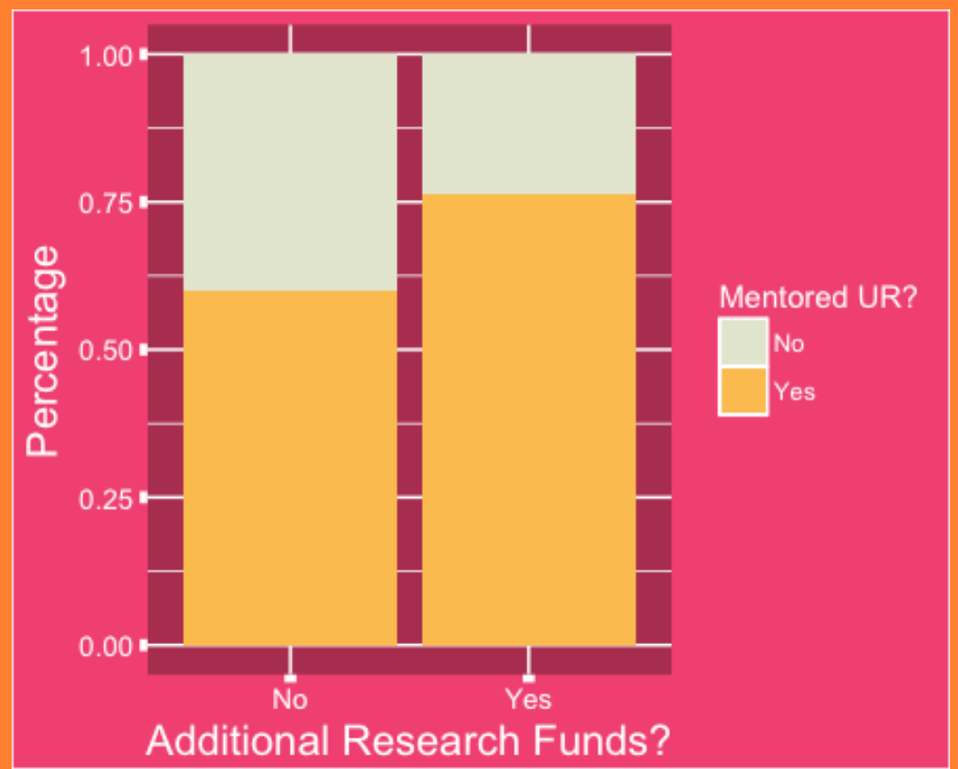
Institution	Valued toward Promotion	Reduced Teaching	Additional Salary	Additional Research Funds
4-year Public (with graduate degrees)	0.61	0.12	0.08	0.10
4-year Private (with graduate degrees)	0.43	0.04	0.13	0.13
4-year Private (without graduate degrees)	0.75	0.19	0.50	0.12
2-year	0.12	0.00	0.38	0.12

- Many people replied that there are no incentives.
- Mostly valued for promotion and tenure.
  - Unfortunately, this incentive is often unclear.
  - What about full professors?
- Additional salary varied by institutions.

Faculty Incentives and Participation







What programs/opportunities are available to <u>incentivize</u> UR for students at your school this year?

- Course credit is a common incentive.
  - Often UR is part of the standard curriculum or an honors program.
    - However, several respondents mentioned that the requirement is often waived.
- Internal funding for UR is most common at the 4-year private institutions without graduate degrees.

Institution	Required	Course Credit	Honors Program	Internal Funding
4-year Public (with graduate degrees)	0.28	0.66	0.40	0.49
4-year Private (with graduate degrees)	0.43	0.65	0.48	0.39
4-year Private (without graduate degrees)	0.39	0.61	0.28	0.94
2-year	0.12	0.38	0.25	0.12

Where do we go from here?

- Stress the value of UR.
  - Tie to the institutional mission.
    - Take our curated list of benefits to your institutional leadership.
  - Also focus on outcomes.
    - Electronic Undergraduate Statistics Research Conference: www.causeweb.org/eusr
    - Undergraduate Statistics Project Competition: www.causeweb.org/usproc
- Argue the importance of counting UR as part of a faculty member's day job.

Where do we go from here?

- Well, after the next four (AMAZING) talks, we go to lunch.
  - If you are interested in talking about…
    - The benefits and barriers you have experienced,
    - Creative strategies for making UR part of faculty's "day job",
    - Where to get the best ice cream in Vancouver,
- Then come see me after the session and let's grab lunch!
- Or, if you have ideas related to UR but can't do lunch/are lactose intolerant, then please feel free to email me: mcconville@reed.edu.