

# **Purdue University: Statistics Living Learning Community**

*by Loran Carleton Parker and Mark Daniel Ward*

## **The Institution and Its Students**

Purdue University is a four-year public research institution and the land-grant university for Indiana. In Fall 2017, enrollment on Purdue's residential campus in West Lafayette, Indiana, was 41,573 students altogether, including 31,006 FTE undergraduate students. Purdue defines a sophomore undergraduate as having 30 to 59 credit hours completed. In Fall 2017, 23.6% of the undergraduate student population (7,329 students) met this definition. The undergraduate student population is 43% female, and 2% of the students are over age 25. Students identify as White (63%), international (16%), Asian (8%), Hispanic/Latino (5%), Black or African American (3%), multiracial (3%), American Indian or Alaska Native (0.1%), and Native Hawaiian or other Pacific Islander (0.08%). Some students did not indicate race/ethnicity (2%). Among the 31006 undergraduate students, 21% were admitted as first-generation students, as self-reported on the admissions application.

## **The Sophomore Initiative**

The Statistics Living Learning Community (STAT-LLC) is an initiative for sophomore undergraduate students at Purdue University. In admitting students to the STAT-LLC, we consider students as sophomores if they have already completed one year of college. This year-round program has been in place since Fall 2014. The program includes 20 students per year, and it is not limited to students pursuing a major in statistics. Moreover, it is often the case that more than half of the students are from outside statistics or even the College of Science.

Indeed, the program is open and welcoming for students from any major in any of the colleges in Purdue University.

The key goal of the STAT-LLC is to train students in computational and statistical skills that are needed for working with the large data sets that are pervasive across all disciplines. This fits Purdue's institutional goals, which including education and research opportunities that enable "data science for all." Purdue's provost, president, and board of trustees are committed to the philosophy that all students—in all majors of study in the university—benefit from learning data science at a level that is appropriate to their major program of study.

The STAT-LLC enables students to perform research in a data-driven project of their choosing. The students work throughout their sophomore year and the summer beyond, under the guidance of a faculty member, and often as part of a larger team of researchers. The students also take probability theory, statistical theory, and a new course in data analysis, designed for the STAT-LLC, together as a cohort. The only assumed background for the students is that they have had enough calculus as prerequisite for the probability theory course. The students all live together a single residence hall and participate in a professional development seminar, with a goal of broadening their understanding of the ways that statistics and data science are used in nearly every field of study and almost every area of commerce, government, and industry.

Very few sophomore-year learning communities in the United States are immersive to this extent (Virtue, Wells, & Virtue, 2017). Our broad team of colleagues, across many units on campus, has worked together to unite the academic, research, residential, and professional development aspects of the sophomore year. We recognize that these disparate aspects of the

college experience are usually disconnected and not planned to work together in unison. When writing the National Science Foundation grant that supports this initiative, we obtained more than 50 letters of collaboration from all types of units on campus: academic advisors; academic departments and colleges; dean's offices, including the Dean of Students; disability resource center; diversity and multicultural offices; Horizons ("developing academic, social, and personal skills through holistic services including tutoring, faculty mentoring, peer mentoring, career development, academic support, cultural enrichment, and access to global experiences"); Honors College; housing and food services; information technology; recruiters; leadership development; libraries; research programs and centers; schedule deputies and the registrar's office; student access, transition, and success programs; as well as a team of external evaluators. We also have more than 50 faculty research projects from which students may choose.

Our students have developed their own characterization of the active learning ("flipped") environment that we use in the probability theory and data analysis courses, suggesting that "The Learning Is Happening." This indicates that the students are not learning from lectures, but rather, they have the autonomy to use the rich resources available to them (e.g., hundreds of videos, lecture notes, problem sets, projects) to learn in the ways that they find most appropriate. All of the activities are student-centered. Peer support and teamwork are key elements of the STAT-LLC. As the students live together and take their courses together, they also help each other (often overnight, for example) as they work through some challenging concepts that would (otherwise) be barriers to success. The students work in teams throughout the year, in their courses and in their research projects. This enables them to be

better prepared to communicate the results of their work to others in ways that are understandable. For instance, they all have different research projects with different faculty members, so they each have a niche area of expertise, which they routinely explain to their peers.

Attrition of women (Margolis & Fisher, 2002; Schaller, 2010; Seymour & Hewitt, 1997), minorities (Collins, 2012; Evenbeck et al., 2000; Museus et al., 2011; Schaller, 2010; Torres, 2003; Torres, Howard-Hamilton, & Cooper 2003), students with disabilities, and first-generation students (Schaller, 2010; Sriram & Vetter, 2010) is problematic during the sophomore year, especially in the mathematical sciences. Adding to the concern is the reality that a relatively small number of women nationally pursue degrees in the computation, mathematical, or statistical sciences in particular or science in general. The LLC creates a welcoming environment for students typically underrepresented in STEM fields. During the 2018-2019 academic year, 70% of the participants are women and one is non-binary. Further, 20% of the students are African American women.

The students and their faculty mentors have published approximately 100 journal articles and presented conference sessions and posters about the research fostered in the STAT-LLC. This level of research productivity for sophomore undergraduate students is rare.

The STAT-LLC has been viewed as such a successful program within Purdue that it will be used as a model for a new initiative called The Data Mine, which will start in fall 2018. The Data Mine is a central piece of Purdue's new Integrated Data Science Initiative (IDSI). Purdue has firm plans and agreements with departments and colleges throughout the university, to have 800 students participating in The Data Mine by Fall 2019. All of The Data Mine students will live

in a specific residence hall; participate in intensive data science seminars; and engage in data-driven projects throughout the year, working in teams with their peers and with faculty and graduate student mentors. Moreover, The Data Mine will expand on the STAT-LLC, allowing undergraduate students from any year to participate.

## **Assessment**

The program collaborates with an external evaluation and research center to design and conduct program assessment. The primary goals of the evaluation are to assess the extent to which the program is meeting its objectives and to provide formative feedback that can improve the program design and outcomes. The evaluation questions include:

1. To what extent has participation in the program enhanced students' self-efficacy for research?
2. To what extent has participation in the program enhanced student awareness of the career pathways available in the data sciences?
3. To what extent has participation in the program enhanced students' research skills, particularly in communication?
4. To what extent has participation in the program provided the students with high-impact educational experiences?

The evaluation design is mixed-methods in nature and includes a program survey administered to participating students at the beginning and end of the academic year portion of the program, as well as, mid- and post-program focus group interviews with each cohort of the program. The survey contains previously validated measures for research self-efficacy and research skills (Adedokun, Bessenbacher, Paker, Kirkham, & Burgess, 2013) and career awareness (Adedokun et al., 2012), as well as, questions about student perception of the program (post-only). The focus group interview protocol contains questions about student experiences with specific components of the program, questions eliciting student feedback on

the program, and questions about student education and career plans. Qualitative data is used for program improvement, rather than summative evaluation.

Pre-post responses for items about research self-efficacy, skills and career awareness are transformed into latent variables through the creation of summative scale scores and the means for each variable are compared across time using paired *t*-tests. Focus group interviews are summarized and condensed such that consistent themes regarding experiences and feedback are recorded.

## Findings

Assessment findings related to the primary evaluation questions—enhancement of research self-efficacy and skills, awareness of career pathways, and participation in high-impact educational experiences—are described in this section.

### *Research Self-Efficacy and Research Skills*

Table X.1 displays the results of paired *t*-tests for variables related to skills for understanding of and confidence with research. Combining data from three cohorts, student research efficacy is not significantly changed over the course of the academic year of the program. However, students reported significantly improved research skills in all three categories (literature, communication, and data). Students also reported significantly improved understanding of the nature and practice of research.

Table X.1  
*Change in Skills Over the Course of the LLC*

<b>Variable</b>	<b>Mean of the Difference</b>	<b>Std. Deviation</b>	<b><i>t</i></b>	<b><i>df</i></b>	<b>Sig. (2-tailed)</b>
Research Efficacy (max 25)	0.53	2.32	1.71	56	0.093
Literature Skills (max 15)	1.35	2.18	4.69	56	0.000
Communication Skills (max 20)	3.14	3.46	6.80	55	0.000
Data Skills (max 20)	2.95	2.79	7.91	55	0.000
Research Practice (max 25)	4.14	3.65	8.49	55	0.000

A significant number of participants (86%) rated the research experience as very or extremely valuable. Students also echoed these results during their focus groups, emphasizing the opportunity of gaining research experience and learning new technology, tools, and software.

### *Awareness of Career Pathways*

Table X.2 displays the results of paired *t*-tests for variables related to career awareness and aspiration for research careers in data analytics and the data sciences. As measured by the pre- and post-program survey, aspirations for research-oriented careers in data analytics are enhanced after the program, but the effect is not statistically significant. Student placement tracking is underway for the first two cohorts. The percent of students who enter an education or career pathway associated with data analytics research will be examined for future reports. Awareness of career pathways in data analytics and the data sciences are significantly enhanced by participation in the program, with scale scores increasing 24%.

Table 2  
*Change in Career Awareness and Research Aspiration Over the Course of the LLC*

<b>Variable</b>	<b>Mean of the Difference</b>	<b>Std. Deviation</b>	<b>t</b>	<b>df</b>	<b>Sig. (2-tailed)</b>
Career Awareness (max 20)	4.82	3.31	11.02	56	0.000
Research Aspiration (max 10)	0.40	1.53	1.99	56	0.052

### *Access to High-Impact Educational Experiences*

Students were surveyed on a variety of indicators related to high-impact educational experiences at the university, including a sense of belonging at Purdue, comfort in talking to professors, confidence in class discussions, locating support networks on campus, and application of class material to real world problems. These high-impact practices are associated

with learning and success in postsecondary institutions (Kligo, Sheets, & Pascarella, 2015). The majority of the 22 survey items did not register any statistically significant change; however, a significant increase in student “participation in study groups” ( $t = 2.334$ ;  $p = .031$ ) was observed. Students also indicated an increase in “getting to know other students with similar interests” ( $t = 2.585$ ;  $p = .019$ ) and in “locating resources on campus that help students like [them]” ( $t = 2.455$ ;  $p = .025$ ).

Furthermore, students appreciated the opportunity to engage various people with industry experience, and 85% of the participants considered the faculty/researcher mentorship component as either very or extremely valuable. In the words of one participant, “I enjoy the ‘humanization’ of a position in academia; I can see profs more clearly as ‘just people.’ This goes for researchers as well.”

All components reflecting the community aspect of the STAT-LLC program were valued highly among participants. On a scale of 1 to 5, with 5 being *extremely valuable* and 1 being *not at all valuable*, peer mentoring received a 4 or 5 from 60% of the participants. The residence hall experience and co-enrollment courses were valued by 75% of the students; and an overwhelming 85% of participants considered the social activities with the group very or extremely valuable. During the focus group interviews, students continuously accentuated the benefit of living and learning in a community and enjoyed “hav[ing] everyone in the same hallway, also to go over course work together.” Participants also emphasized the cohort-feeling established through the program since majors like actuarial science are not set up so that every student of the same class standing takes the same courses together. One participant summed



up their experience in the STAT-LLC program as “definitely one of the best experiences here [at Purdue] for me!”

## **Alignment for Student Success**

Purdue adopted the Foundations of Excellence process, developed by the John N. Gardner Institute for Excellence in Undergraduate Education, to guide institutional objectives for first-year students. One key objective is retention of students from the first year into the sophomore year. The pace of learning within the STAT-LLC itself is fast, but there are no hurdles, in terms of first-year prerequisites. In other words, the STAT-LLC does not assume that students have backgrounds in programming. Thus, regardless of whether the students took (for instance) computer science courses as first-year students, they are able to make degree progression from their first year into their sophomore year in the STAT-LLC.

Drawing on data from Russell et al. (2007), Wilson and Crowe (2010) found 13% of universities offer sophomore/junior seminars, while 90% offer first-year and senior seminars. By incorporating professional development seminars into the STAT-LLC, the students continue to grow in their understanding of the many data-driven disciplines. They are able to connect the skills learned in these seminars with the research opportunities during their sophomore year and beyond. These seminars help to tie their first-year college development to their development as early career researchers during their junior and senior years.

Students who have performed research in the sophomore year are also better prepared for research during their junior year and for capstone experiences during their senior year, as compared with students who did not begin to do research as sophomores. Besides being better prepared, our STAT-LLC students are able to build on their sophomore-year experiences

and go more deeply into the scientific content of their research during their junior and senior years. During conference talks and seminars, our students are often mistaken for graduate students, due to their pose, maturity, and depth of understanding of the research in their respective projects.

As the NSF grant ends in 2019, Purdue is preparing to institutionalize and ramp this project up to approximately 800 students per year, starting in fall 2019. We will provide more information about this expanded initiative in future publications.

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## Contact

Dr. Mark Daniel Ward  
Professor, Department of Statistics  
Purdue University  
Phone: 765-496-9563  
Email: mdw@purdue.edu