IRIS
INSTITUTE FOR
RESEARCH ON
INNOVATION & SCIENCE

2020 Year in Review

Data to understand, explain and improve the public value of research and higher education

As we celebrated IRIS' fifth birthday in January, 2020 we had high hopes for the year to come — to enhance data offerings through new partnerships, to expand our membership base, to enable a broad range of high quality research, and to provide data products of value to policy-makers, universities and stakeholders across the country.

Obviously, 2020 didn't work out like anyone had planned. But nevertheless, I am proud of our progress toward IRIS' goals, and we're excited to build on the gains we've made in the last year.

Despite the turmoil that COVID-19 created on campuses across the country, IRIS members joined together to participate in an extremely valuable pilot study of the pandemic's impact on academic research. Thank you to all our members who supported this important work by submitting fresh data to IRIS in the midst of all the year's distractions.

Despite working home for most of the year (and the countless hours of zoom meetings that has entailed for everyone) the IRIS team accomplished a phenomenal amount – from development and release of new reports using new data, to new training workshops and member outreach webinars, to releasing a stellar new research dataset with information on nearly half a million federal and non-federal sponsored projects.

As we move on to 2021, and hope for a better year, I want to express my heartfelt thanks to the IRIS team, to our members, researchers and everyone else whose work makes IRIS such a special organization.

As the COVID pandemic enters a new, recovery-oriented phase, IRIS is better equipped than ever to contribute data, knowledge, and analytic products to characterize those effects in rich detail and to inform the process of recovery for research. Soon after the pandemic hit, we reached out to our member universities requesting their most recent administrative data on research-related spending and employment — the result was that 10 member universities provided data that informed our "COVID-19 Impact Report."

That report, and a fact sheet about the economic impacts of research overall, proved important to higher education associations and lobbyists seeking to secure relief for research universities. Our data was cited in congressional testimony, and in a "Dear Colleague" letter that was supported by more than 180 members of the U.S. House ().

IRIS will continue to expand our ability to serve our members, our researchers, and the nation in 2021.

Thank you, as always for everything you do with and for IRIS. I hope you all remain safe and healthy.

Happy New Year.

Jason Owen-Smith
IRIS Executive Director
Professor of Sociology, University of Michigan

Contents

2020: Moving forward in challenging times

4th annual IRIS data release

Our fourth annual data release was made available in the IRIS virtual data enclave (VDE) in July. The dataset includes information on research spending, vendor contracts and employees from research institutions representing 41% of total U.S. university R&D spending. The IRIS dataset has been used by researchers in higher education, economics, sociology, and many other fields.

New features this year include:

- An indicator for federally sponsored projects
- Standardized names for non-profit foundations
- Standardized sub-organization unit names
- Expanded demographic variables
- Linking between federal award and UMETRICS data at both award and individual PI levels
- New linkage files focused on research teams

2020 Data Release

Nearly **450,000** funded awards at **33** IRIS member universities

$99 billion in award spending

Payments to more than **900,000** vendors

New features:
Expanded demographic variables

New linkage files to create a research team-based dataset

Wages to about **720,000** employees

For more, see iris.isr.umich.edu/research-data

Webinar series highlights year's accomplishments

IRIS broadcast a series of webinars this year to bring attention to some of our most notable accomplishments.

With IRIS staff and that of most universities working from home, we hope that these videos will make it easier to stay up to date with our work over the past year.

Tracking the Career Outcomes of Research-Funded Employees   *https://youtu.be/K6sh0GpOdT4*

IRIS Technical Director Kevin Bjorne gives an outline of the new IRIS Employee Report

Data on the Impact of COVID on U.S. Research   *https://youtu.be/jTjthItMQVw*

IRIS Executive Director Jason Owen-Smith is joined by Jay Walsh, Vice President for Economic Development and Innovation at the University of Illinois System, to discuss the need for data on COVID's impact on research, and IRIS' attempt to fill the void.

Using IRIS Data in Government Relations   *https://youtu.be/ovqF1UcTvL8*

University of Michigan Federal Research Relations Director Kristina Ko talks about how she uses data to educate federal lawmakers on the impacts of research funding.

The IRIS Impact Finder   *https://youtu.be/7Z-Wua5Ju5E*

IRIS Executive Director Jason Owen-Smith reviews the new tool to find research stories with impact.

The IRIS Vendor Profile Report   *https://youtu.be/v8CRf1w3eY0*

IRIS Executive Director Jason Owen-Smith outlines the new IRIS Vendor Profile Report.

The impacts of COVID shutdowns

Report and fact sheet show effects on research universities

When COVID-related university research shutdowns spread across the country this past spring, IRIS produced some of the first data and analyses showing the effects on universities, the economy, and the workforce.

First, in April, we released a fact sheet titled "The Impact of American University Research Spending" which outlined the role of the research ecosystem in the country's economy and workforce development.

Some of the top-line numbers from that report, which aggregates data from all IRIS members and uses them to estimate figures for the entire country for fiscal years 2018-2019:

- All U.S. universities spent nearly $14 billion of direct cost research dollars on goods and services.
- Of that amount, approximately $3.7 billion was spent on businesses in the same state as the university that conducted the research.
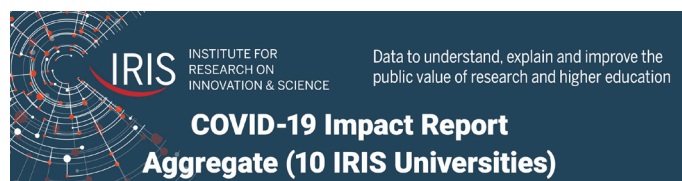- More than $2.5 billion was spent in purchases from manufacturing firms.

- Universities paid more than 560,000 people on campuses across the country, more than 53% of whom were students or trainees.

Later in the year, we distributed the "COVID-19 Impact Report," using data from 10 IRIS member universities. This was one of the first data analyses of the implications of the first few months of the shutdown of research operations at universities across the country.

The report shows the steep decline in federally and non-federally funded research vendor spending during the first three months of the pandemic (March - May 2020).
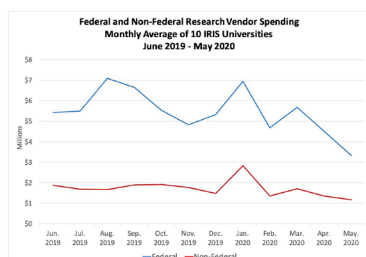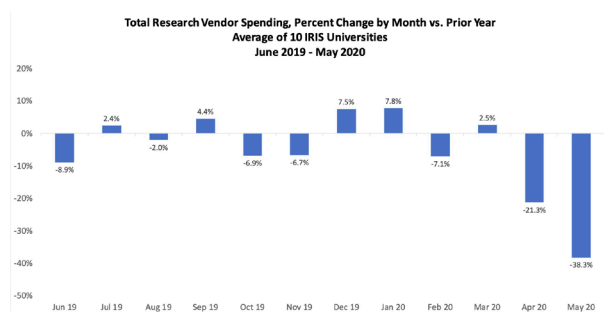
Vendor purchases are a leading indicator of how much university research capacity is active. This suggests that by May these universities were working at around 70% research capacity on average.

The report also highlighted that students were the hardest hit in terms of job losses. Of the top five federal funding agencies, students lost the most jobs in NSF and NIH funded projects.

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Data to understand, explain and improve the public value of research and higher education

COVID-19 Impact Report
Aggregate (10 IRIS Universities)

This report documents the impacts of the COVID-19 pandemic and associated shutdowns among 10 IRIS member universities. Data were collected from June 2018 through May 2020.

Spending on Research-Related Goods and Services

Total Research Vendor Spending, Percent Change by Month vs. Prior Year
Average of 10 IRIS Universities
June 2019 - May 2020

Federal and Non-Federal Research Vendor Spending
Monthly Average of 10 IRIS Universities
June 2019 - May 2020

These charts show the steep decline in federally and non-federally funded research vendor spending during the first three months of the pandemic (March - May 2020).

Vendor purchases are a leading indicator of how much university research capacity is actively. This suggests that by May these universities were working at around 70% research capacity on average.
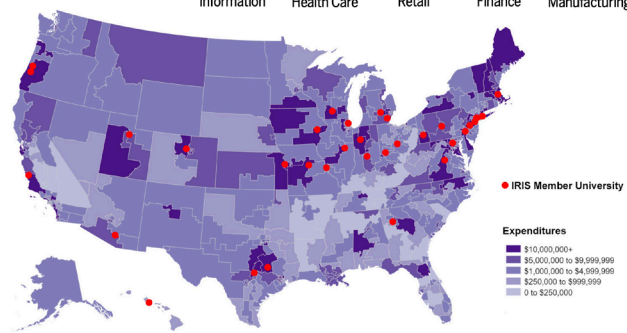
The charts on the second page show that students were the hardest hit in terms of job losses. Of the top five federal funding agencies, students lost the most jobs in NSF and NIH funded projects.

The Impact of American University Research Spending

America's leading research universities generate groundbreaking scientific knowledge. Their research also plays a substantial and immediate role in the U.S. economy. The Institute for Research on Innovation and Science (IRIS), using detailed spending data from 400,000 funded research projects at 33 universities representing more than 41% of all university research and development spending in the country, estimates that in fiscal years 2018-2019, **all U.S. universities**:

- **Spent nearly $14 billion** of direct cost research dollars on goods and services in all **435 congressional districts** to support on-campus research activities
- Of that amount, approximately **$3.7 billion was spent with businesses in the same state** as the university that conducted the research
- More than **$2.5 billion was spent in purchases from manufacturing firms**, a figure equivalent to $203 per employee (based on BLS estimates of 2018 employment)

Top industries providing goods and services to support university research include:

Information   Health Care   Retail   Finance   Manufacturing

● IRIS Member University

Expenditures
- $10,000,000+
- $5,000,000 to $9,999,999
- $1,000,000 to $4,999,999
- $250,000 to $999,999
- 0 to $250,000

This map shows the nationwide distribution, by congressional district, of research purchases from 33 of America's leading research universities (represented by red dots) that are members of the Institute for Research on Innovation and Science (IRIS). IRIS members account for more than 41% of total U.S. academic research and development spending.

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Data to understand the pandemic

IRIS data and analyses used by lobbyists and lawmakers

University association lobbyists and federal lawmakers advocating for financial relief for American research universities took advantage of IRIS reporting in various ways:

- The IRIS fact sheet on the impacts of university research spending was cited by Jay Walsh, Vice President for Economic Development and Innovation, University of Illinois System, at a congressional hearing on the effects of the

COVID-19 pandemic on university research. Walsh spoke to the Subcommittee on Research and Technology Subcommittee of the U.S. House Science Committee on Sept. 9, 2020. His written testimony cited the fact that approximately 53% of employees paid by research funds are students or trainees, including post-doctorate researchers.

- The fact sheet was cited in an article in the Policy Forum section of Science, co-written by authors from the University of Michigan, Stanford University, Johns Hopkins University, University of California at Berkeley, the Massachusetts Institute of Technology, and the University of Washington. The piece provides guidance for a phased-in ramp-up of scientific research after the COVID-19 pandemic.

- The IRIS fact sheet was also a key supporting document in a "Dear Colleague" letter co-sponsored by Reps. Fred Upton, R-Mich., and Diana DeGette, D-Colo., calling for funding relief for university-based research. The letter was supported by 182 members of the House.

Sloan funding will help build next round of COVID data

IRIS received a $500,000 grant from the Alfred P. Sloan Foundation to study the effects of COVID-19 on university-based scientific research.

The support from the Sloan Foundation will allow IRIS to continue its work to understand the full impact of the pandemic on research operations at member universities, and to expand the number of universities included in the data analyses.

"The American research enterprise's response to the COVID pandemic has wide-ranging and significant implications for the global standing of U.S. research and development," said Jason Owen-Smith, IRIS Executive Director, and Professor of Sociology and Executive Director of

Data Analytics at the University of Michigan. "A better understanding of the reactions to this downturn can help us prepare for the next one, and strengthen the university-based research that is such a huge driver of scientific discovery and economic prosperity."

New data that result from the project will be publicly available to any researcher in the U.S. as a supplement to IRIS' existing dataset.

Daniel Goroff, Vice President and

Program Director at the Sloan Foundation, said the project fits well into the foundation's focus on understanding and improving the functioning of science and technology development: "IRIS is unique in its ability to compile, link, and analyze data about research spending both on and by universities. Those data are especially important while COVID threatens the immediate vitality of institutions and individuals as well as the long-term vitality of innovation and economic growth. IRIS and its partner universities are making major contributions to understanding higher education at this critical moment."

The Sloan Foundation was one of the original supporters of IRIS when it was founded in 2015.

Advancing social science research

NSF-funded workshop set for second session in Summer 2021

IRIS held a week-long virtual workshop in June 2020 focused on how to leverage big data resources and tools to advance education and social science (ESS) research.

This was an introductory-level course aimed at researchers in education and social science fields who are interested in gaining experience working with large-scale restricted-use data.

In this hands-on class, participants learned about large-scale datasets with the goal of achieving a better understanding of the research questions that can be answered with big data.

The workshop featured a dataset on the makeup of research teams.

Participants acquired skills that will enable them to pursue external funding for ESS research using big data. In addition to technical skills, participants worked with established investigators to develop and present ideas for projects that might be submitted to NSF grant competitions.

Supported by the NSF, the workshop is designed to help investigators from a wide range of backgrounds and disciplines acquire the tools and knowledge to secure grant funding

for data-driven social science and education research.

The workshop will run again this summer. Visit iris.isr.umich.edu/training for more information.

2020 Researcher Update

Over **1,000** help tickets answered since 2017

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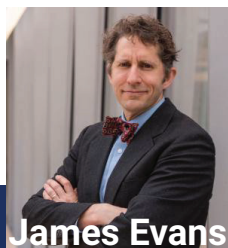
Nearly **250** researchers from **84** institutions have accessed the IRIS virtual data enclave

51% of VDE users are faculty/staff
39% are students
10% are post-docs

James Evans
Professor of Sociology
University of Chicago

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IRIS Researcher Award Recipient

2020

Project: The Impact of Strategic Funding on Research Type and Content

Research Team:
Donghyun Kang, PhD student
Clara del Junco and Simon Shacter, Post-Docs

James Evans at the University of Chicago won the 2020 IRIS Researcher Award.

The awards are supported by the Alfred P. Sloan Foundation,. For a listing of previous awardees, visit iris.isr.umich.edu/awards-fellowships.

Researcher Q and A — Lisa Cook, Michigan State University

From testifying on Capitol Hill to writing an opinion piece on the pages of the New York Times, Dr. Lisa Cook has helped bring new attention and research focus to racial and gender inequalities in economic and academic opportunities and outcomes. Now, she is using IRIS data to continue her research by looking at how such inequalities are manifested in the "innovation economy," through the interactions of patent awards, wealth creation, and research training.

Cook, an Associate Professor of Economics and International Relations at Michigan State University with an appointment at the University of Michigan's Institute for Social Research, was a recipient of an IRIS researcher award in 2018 for her project "The Idea Gap in Pink and Black." This research is using IRIS data to explain the mechanisms underlying the differences in applying for, obtaining, and commercializing patents experienced by African Americans and women.

In this question-and-answer session with IRIS, Cook talks about her approach to her research, the potential of IRIS data and products, and her attempts to isolate the causes of racial and gender disparities.

Q: Please describe your current research.

A: What factors effect invention and innovation, that's the overarching question. Now, I'm looking at racial and gender disparities in invention and innovation at every stage of innovation. [The first stage is] training and basic education in STEM, and the second would be the actual practice of invention, like working in a lab, coming up with a patent. And then the third would be commercialization, and IPOs for example. So at every stage what we see is that there are gaps, and they just grow at each juncture. And I think it's interesting, and I want to get to the bottom of it using UMETRICS data. I want to figure out where these disparities come in, especially starting with education and training...

One theory is that women receive less funding at the educational stage, which carries over into the invention stage... they aren't in those funding networks and they have lower productivity with respect to patenting in the middle. And then that has implications for the end, or they may never get to the end because they may never have had a patent.

So, I'm looking at that. I'm looking at the same for African Americans... But I'm also now looking at something a bit broader. I'm looking at inequality, because we know STEM economy incomes or innovation economy incomes are much higher, two to three times higher than the average salary in the United States.

You have this disparity that happens in the beginning and then it becomes larger in the middle if you're talking about income. But then if you move to the third stage, we start talking about wealth and wealth inequality. Ten of the most valuable companies by market capitalization are tech firms, and seven of the ten richest people are related to tech... Women are largely absent. There's a direct relationship between all three stages. So I'm writing about the inequality that arises from a lack of participation in every stage.

Q: How will working with the IRIS UMETRICS data help you answer these questions?

I can look at graduate students, and even undergraduates who participate on research teams on awards, and I can follow them to further awards, and I can follow them to other outcomes... But if I can just trace out who was working on what research team, and what the trajectory was over time, that's the helpful first stage. And then ultimately we should have them matched to patents and that should be telling.

Q: What might some of the applications of this research be in order to increase participation of women and African Americans in STEM education and the technology workforce?

A: It might be thinking more broadly about how professors assemble labs, making a workplace or lab culture that's friendlier to people, for example, who have disproportionate childcare obligations.

One of the most telling things that I heard at large Silicon Valley tech firms in my visits there was asking people about women on their patent and design teams... What they said was they noticed that women were penalized because they weren't there 24/7... And they may be working on a project, but her voice isn't there [after normal working hours], so she isn't considered a contributor even though between 9 and 5 she's contributing... So I think there are some interventions that have nothing to do with resources, just having people be more thoughtful about work time, the way they work.

This interview was conducted and edited by IRIS Communications and Marketing Coordinator Dan Meisler.

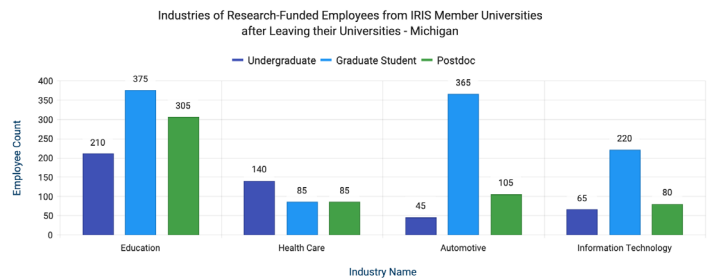# Expanding data collaborations

Data exchange with Atlanta-based Steppingblocks yields new details on locations and industries of research employees

In fall 2020, IRIS sent out a new version of the Employee Profile Report including data from Steppingblocks, an Atlanta-based data provider.

With the new data, IRIS is able to show much more detailed information on the jobs taken by former research employees -- separable by undergraduate, post-doc, faculty and staff -- after leaving IRIS member campus, in terms of both earnings and employers.

Aggregating the data from all IRIS members, some of the findings from the new report were:

- The top three states for research-trained university employees to find work are California, New York and Illinois.

- The most lucrative industry for employees who were post-docs on university projects is finance, with a median income of $110,209; for staff and faculty, the legal field had the highest median incomes ($112,250 and $98,395, respectively); and for graduate students, telecommunications at $99,223

Industries of Research-Funded Employees from IRIS Member Universities after Leaving their Universities - Michigan

Screen shot from the aggregate version of the IRIS Employee Profile Report.

- Overall, the education, health care, information technology and life sciences industries were the top employers for people who had worked on sponsored projects at universities either as students, faculty or staff.

The Employee Profile Report containing U.S. Census Bureau data linkages will be available to members as a supplemental report later in 2021.

IRIS working with Duality Technologies on encryption project

IRIS and Duality Technologies, a leading provider of Privacy-Enhancing Technologies (PETs), along with NumFOCUS, a non-profit organization which sponsors the use of open-source software in research, data science and scientific computing, began a project together this year aimed at developing an open-source homomorphic encryption (HE) library to carry about secure analysis of sensitive student data while keeping personally identifiable information private.

The new framework will offer academic institutions and public agencies tools to conduct privacy-preserving research on the impact and the societal benefit of financial support for students. Previously, researchers had not been able to comprehensively analyze relevant data held by different public agencies due to data privacy regulations and agencies' reluctance to share such sensitive information. Socio-economic data indicative of scholarship recipients' lifestyles and occupations are inherently sensitive and until now, researchers had to undertake cumbersome anonymization processes with available data, limiting the studies' scope and reliability.

The development of the framework is also supported by the Alfred P. Sloan Foundation, which issued a grant to NumFOCUS to promote the development of the open-source software for scientific research.

The framework utilizes homomorphic encryption, an advanced encryption method that protects data during computation, allowing multiple parties to run privacy-preserving analytics on encrypted data. Already deployed and proven in the financial industry, this will enable academic institutions and public agencies for the first time to comprehensively measure the impact of their grant-making and to maximize the impact of such support for students.

IRIS and XSEDE team up to study effects of supercomputer access on scientific productivity

IRIS and the eXtreme Science and Engineering Discovery Environment (XSEDE) completed a pilot project examining the scientific and near-term economic impact of researcher access to XSEDE's advanced research computing resources and services.

IRIS linked XSEDE data on the resources it has awarded to researchers since 2011 to the UMETRICS dataset with transaction-level data on sponsored research projects from dozens of the nation's leading higher educational institutions. This resulted in a new way to examine how access to supercomputing and digital resources influence the productivity of academic research teams.

Over 1,000 XSEDE researchers were successfully linked to employees in the UMETRICS dataset. Linked projects were broadly representative of the wide range of scientific fields using XSEDE, and IRIS could directly measure

contexts and outcomes of roughly 2,300 allocations—about one fifth of all XSEDE awards. Using propensity score matching techniques, a subset of research teams which had received an initial XSEDE allocation were matched to similarly situated control teams.

During the two years immediately following initial XSEDE allocations, these new XSEDE research teams increased scientific productivity compared to control teams. The average XSEDE team published one additional article per year than matched control teams, a result robust across multiple modeling approaches. Additional findings were more sensitive to specifications but suggested that XSEDE teams may both expand to new federal funding sources (averaging 9% adding a new funder) and increase grant funding (averaging 15% more federal research dollars) relative to matched controls.

XSEDE
Extreme Science and Engineering Discovery Environment

"This project provides a new method to understand, explain and improve large-scale investments such as cyberinfrastructure that enable research across a wide range of academic domains," said IRIS Executive Director Jason Owen-Smith.

"This study is part of an ongoing effort by XSEDE to find means to articulate the value brought to the community and the impact on the advancement of science across the country through investments such as that made by NSF in XSEDE," said John Towns, principal investigator of the XSEDE project and Executive Associate Director of Engagement at the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign.

Virtual IRIS annual meeting coming March 18

Due to the COVID pandemic, we have delayed our annual meeting until the spring and will hold it virtually. We are developing a shorter program than the typical in-person IRIS Summit.

Please join us March 18 at 1 p.m. ET.

Register at myumi.ch/VPOmQ

Keep an eye out for more details to come; please contact **IRIS-info@ umich.edu** with any questions.

Board elections set for spring

There are four vacancies on the IRIS Board of Directors that will be filled in an election scheduled for late April and early May.

Members serve two- or three-year terms.

Please send nominations, including self-nominations, to Nancy Calvin-Naylor at **nbirk@umich.edu**. Nominations should include a short bio and statement of vision for IRIS, not to exceed 1 page combined.

IRIS Researchers and Staff

Najla August
Lead Developer

Kevin Bjorne
Technical Director
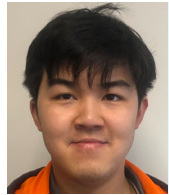
Amy Butchart
Lead Programmer

Nancy Calvin-Naylor
Managing Director

Nazha Gali
Research Fellow

Elissa Irhamy
Research Support Associate

Jinseok Kim
Research Assistant Professor

Raphael Ku
Data Support Specialist

Natsuko Nicholls
Research Manager

Dan Meisler
Communications and Marketing Coordinator

Jason Owen-Smith
Executive Director

Rob Truex
Programmer Intermediate

Matt VanEseltine
Research Investigator

Meg Weideman
Administrative Assistant

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Karen Woollams
Business Manager

IRIS board approves new membership options

The IRIS Board of Directors approved a phased membership system that provides a number of cost-saving options. Universities that start at a lower option would agree to ramp up to full membership after a year.

Option 1

Cost: Free

Benefits:

- Federal Legislative Report

Option 2

Cost: $10,000/year

Benefits:

- Federal and state legislative reports
- Researcher access to annual data release
- Voting rights in IRIS Board elections

Option 3

Cost: $20,000/year

Benefits:

- Federal and state legislative reports
- Researcher access to annual data release
- Voting rights in IRIS board elections and participation in planning committees
- Access to IRIS Impact Finder with single-state availability

See iris.isr.umich.edu/membership for more information.

Full membership

Cost: $25,000

Benefits:

- All of the tools in Option 3
- IRIS Impact Finder with national access
- Campus Spending Report
- Vendor Profile Report
- Employee Profile Report
- New reports under development
- Ability to nominate and elect IRIS Board members
- Waiver of seat fees for researcher access to annual data release

IRIS reports and tools at a glance

Legislative Reports: Contains details of research vendor spending by federal and state legislative districts

Impact Finder Tool: Provides a user-friendly way to browse IRIS data to find stories on the impact of research spending

Spending Report: Provides a comprehensive picture of the people, goods and services supported by sponsored research

Vendor Profile Report: Details the economic impact of research spending at the national, state and county levels, and by industry

Employee Profile Report: Shows locations and industries of former research-funded employees when they leave a member university

More: iris.isr.umich.edu/reports-and-products

IRIS Membership as of Jan. 1, 2021

- Boston University
- Cornell University
- Emory University
- Johns Hopkins University
- Michigan State University
- New York University
- Northwestern University
- Ohio State University
- Pennsylvania State University
- Princeton University

- Rutgers University
- Stony Brook University
- Texas A&M University
- University of California – San Diego
- University of Illinois – Urbana Champaign
- University of Kansas
- University of Michigan
- University of Missouri

- University of Oregon
- University of Pittsburgh
- University of Utah
- University of Wisconsin – Madison
- Virginia Polytechnic Institute and State University
- Washington University in St. Louis

IRIS Board Members

Elizabeth Adams
Director, Office of Research and Project Administration, Princeton University
Term: June 1, 2019-March 31, 2022

Kimberly Griffin
Director for Electronic Research Administration, Northwestern University
Term: April 1, 2017-March 31, 2021

James Hilton
Vice Provost for Academic Innovation, University Librarian & Dean of Libraries, University of Michigan
Term: April 1, 2017-

Michael Holland
Vice Chancellor for Science Policy and Research Strategies, University of Pittsburgh
Term: June 1, 2019-March 31, 2022

Rodolfo Torres
Vice Chancellor for Research and Economic Development, University of California, Riverside
Term: April 1, 2018-March 31, 2021

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