

The Power of Data for Decision Making and the Appropriate Use of Analytics in Higher Education Settings

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Overview

- Role of data and analytics in higher education today and in the future
- Definitions and sources of data
- Use of data to improve student learning and success
- Ethics, social justice, security, and privacy
- Questions and discussion

Role or Use of Data

- Enhance student achievement
- Plan courses and curriculum
- Recruit and retain students
- Optimize the scheduling of classrooms
- Understand levels of student engagement



Value of Data for Decision Making

- The ability to make effective decisions is crucial if an institution of higher education is going to continuously improve student learning and success.
- Data helps decision makers evaluate alternatives, make resource allocations, and make informed choices.
- Must have reliable and timely data (quantitative and qualitative) upon which to make decisions.
- The development of effective data management and analysis techniques is of central importance.
- Many decision makers find that using data is no easy task as they find themselves inundated with nearly overwhelming amounts of data.

What Technology Can Do for Decision Support

- Improve data processing speed.
- Allow us to summarize multiple data points.
- Visualization platforms – Tableau.
- Improve access via self-service tools.

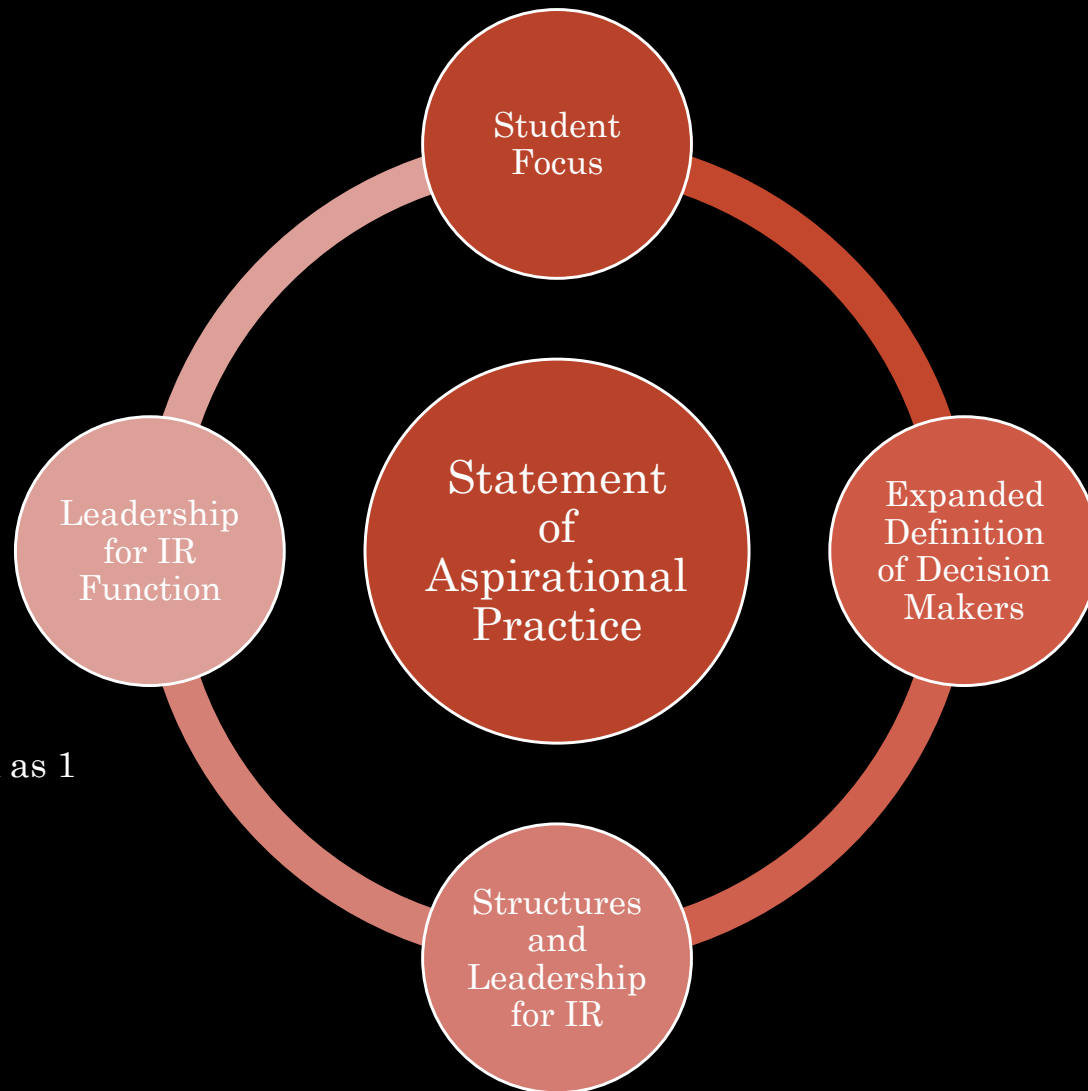
What Technology Can't Do for Decision Support

- More complex the task, more difficult to replace with technology enabled tools.
- Decide on research design and even appropriate statistical test or algorithm.
- Understand complex data questions posed by decision makers.
- Consider ethical use of data for decision making.

Statement of Aspirational Practice For Institutional Research – Association of Institutional Research (AIR)

- “Data are everywhere across institutions of higher education, and access to analytical tools and reporting software means that a wide array of higher education employees can be actively involved in converting data into decision-support information.”
- “The demand for data to inform decisions in postsecondary education is greater than ever before. Colleges and universities have significantly increased capacity to collect and store data about student and institutional performance, yet few institutions have adequate capacity for converting data into information needed by decision makers.”

Statement of Aspirational Practice For Institutional Research



IUPUI Selected as 1
of 10 Founding
Institutions

IRDS Activities and Reports to Support Assessment of Student Learning and Success

Institutional
Research
(Retention and
Graduation Rates)

Strategic
Enrollment
Management

Assessment of
Student Learning
and Development
(course
evaluations)

Survey Research
Methods

Program
Evaluation and
Program Review
(assessing what
works and what
needs
improvement)

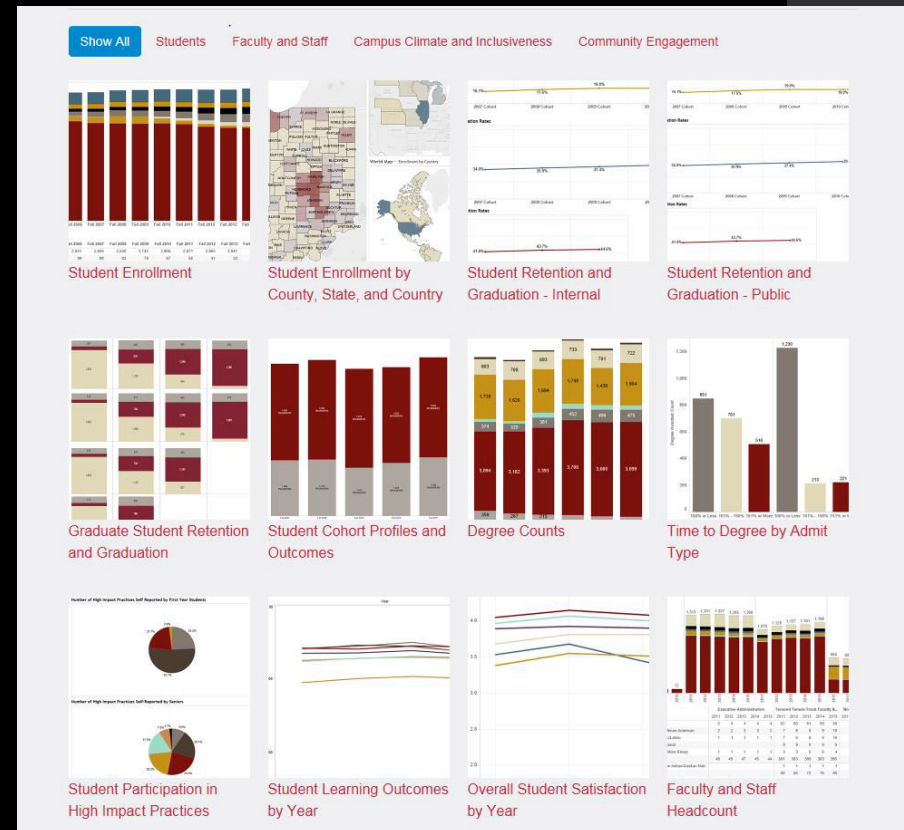
Institutional and
Strategic Planning
Decision Support

Leverage Technology-Data Visualization Platforms such as Tableau for Accessible Self-Service Data Tools

Institutional Research and Decision Support

<https://irds.iupui.edu/>

Contains highly interactive dashboards allow users to drill down and filter to allow detailed exploration of key indicators associated with the IUPUI Strategic Plan.



Key Practices and Strategies to Build and Support Culture of Data Use

- Engage in efforts to understand the anatomy of decision making across campus (who makes decisions, when, how, and what data is needed).
- Building data literacy, evaluation, and assessment capacity across IUPUI so that information exploration, interpretation, and analysis are used to support evidence-based decision making and improve institutional effectiveness.
- Provide consultation on assessment of student learning, program evaluation, survey research methods, and advanced statistical analysis procedures.
- Deliver training and data tools that allow decision makers to leverage data and information.



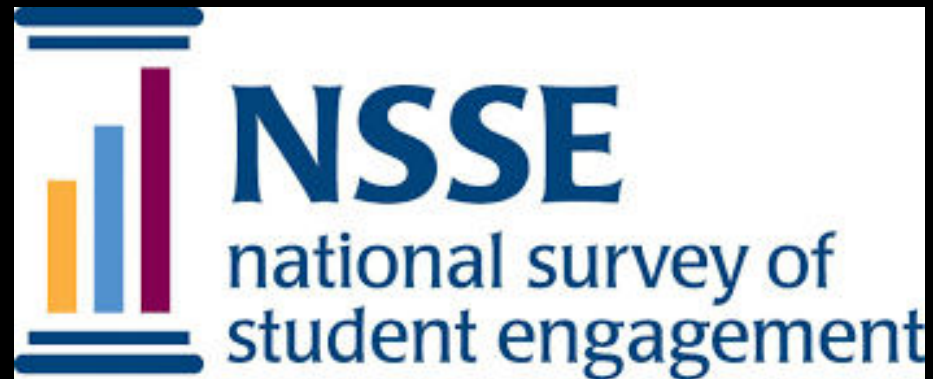
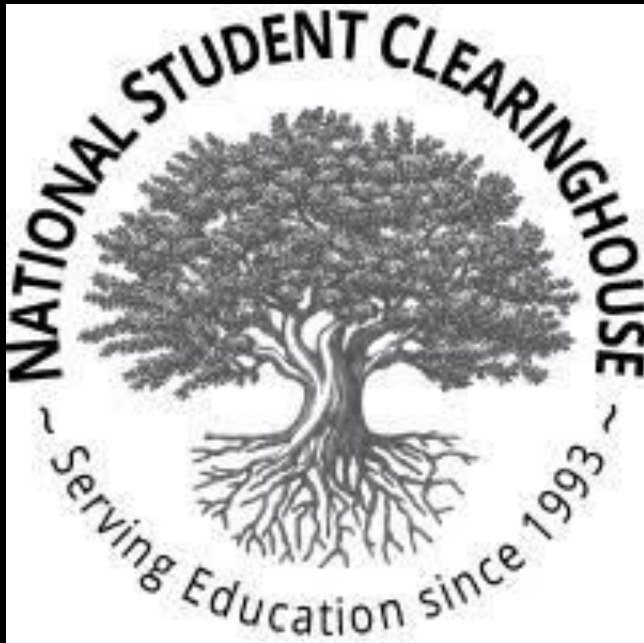
Sources of Data for Decision Making and Definitions

Institutional Research

- Institutional research is a broad category of research activities conducted at schools, colleges and universities to inform campus decision-making and planning in areas such as admissions, financial aid, curriculum, enrollment management, student success and learning, staffing, student life, finance, facilities, athletics, and alumni relations.
- Typically involves research conducted for internal decision making, planning, and external accountability reporting.
- Purpose is primarily to improve institutional effectiveness and not to generalizable research or inquiry.



National Data Sources



Assessment

- *Assessment* is often defined as a continuous cycle of improvement and is comprised of a number of features: establishing clear, measurable expected outcomes of student learning; ensuring that students have sufficient opportunities to achieve those outcomes; systematically gathering, analyzing, and interpreting evidence to determine how well student learning matches expectations; and using the resulting information to understand and improve student learning” (Suskie, 2009, p. 4).

Statistical Analysis In Higher Education

- Statistical methods involved in carrying out a study include planning, designing, collecting data, analyzing, drawing meaningful interpretation and reporting of the research findings.
- Gives meaning and often involves inferences.
- Requires and an understanding of quantitative and qualitative variables, measures of central tendency, sample size estimation, power analysis and statistical errors/assumptions.
- Requires a proper design of the study (understanding of research methods) and choice of a suitable statistical test.
- Improper statistical methods may result in erroneous conclusions which may lead to unethical practice.

High-Risk Factors Associated with Poor Student Success and Attrition

- Poor Performance in first semester or Earning DWFI in a course
- Low high school or transfer in GPA (lower than 3.00)
- Under-Resourced (high levels of unmet financial aid, low-income)
- Late Registration Date
- Not having Academic Honors Diploma or Rigorous High School Curriculum
- Attending part-time and not enrolling in 15 or more credit hours
- Not Placing into Credit Bearing Math
- Transferring in with few hours with no degree

High-Risk Factors Associated with Poor Student Success and Attrition

- First Generation College Student
- Not Participating in High Impact Practices and Early Interventions First Year (FYS, Themed Learning Communities, Summer Bridge)
- Living Off-Campus
- Living Alone or With Others Not Attending IUPUI
- External commitments (working for pay off-campus, commuting, taking care of dependents and household responsibilities)
- Low self-efficacy, sense of belonging, commitment to IUPUI (intent to transfer)

2017 Themed Learning Community Impact on First Year GPA: ANCOVA Results

	N	Avg. Fall GPA	Adjusted Fall GPA*
TLC	936	2.76	2.79
Non-Participants	2374	2.74	2.73
Overall	3310	2.74	

Note 1: Only Full-Time FYS participants. Students who withdrew from a TLC were counted as non-participants. Excluding students who were missing data on one or more covariates.

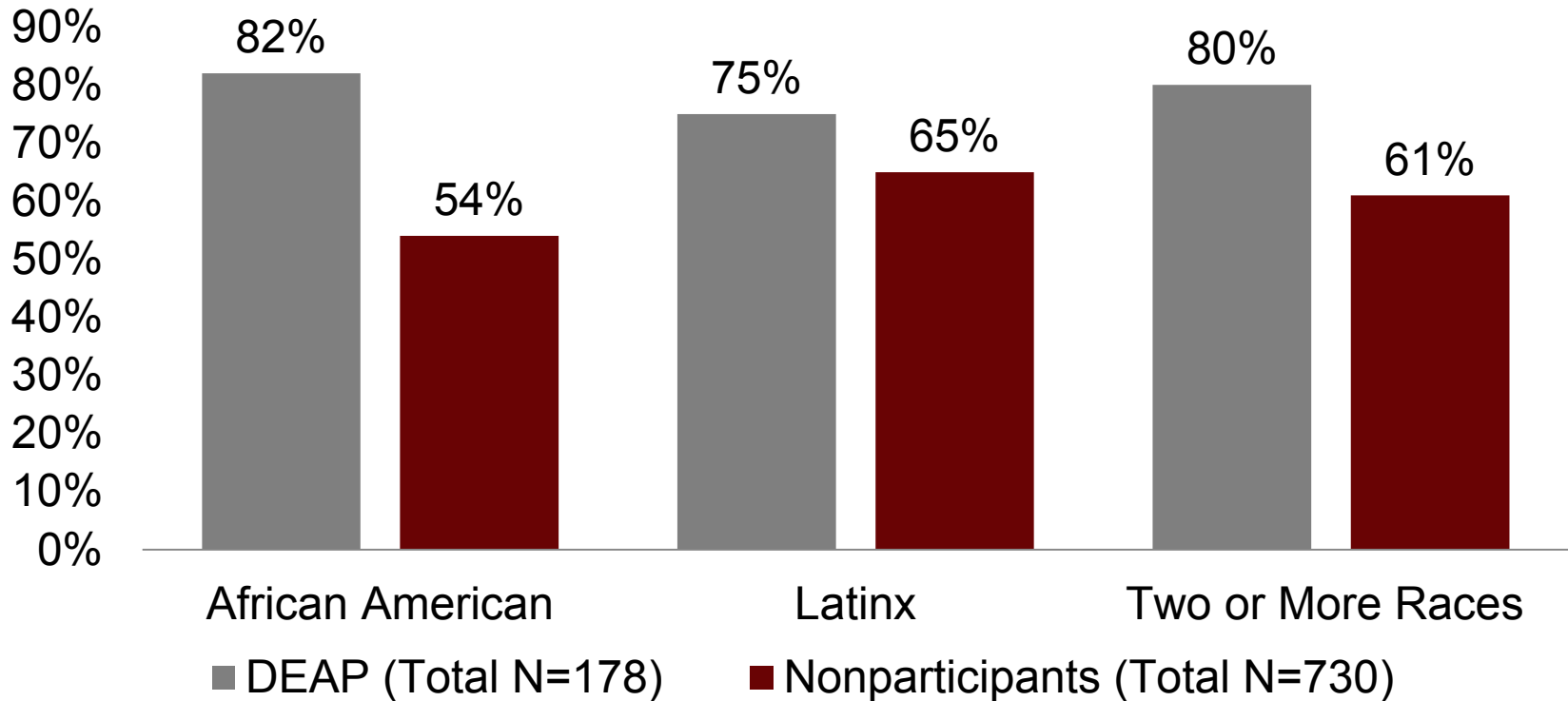
Note 2: Differences were statistically significant based on Analysis of Covariance (ANCOVA) results ($p < .048$).

Note 3: Partial Eta Squared indicated a very a small effect size.

* Covariates included in the model were High School GPA, SAT Score, Enrollment Date (proxy for student motivation and commitment), and Income Level (received a Pell Grant or Not dummy coded where 1 = Received Pell Grant and 0 = Did Not Receive a Pell Grant) and Gender.

Diversity Enrichment and Achievement Program (DEAP) Retention

Fall-Fall Retention – Retained IUPUI IN

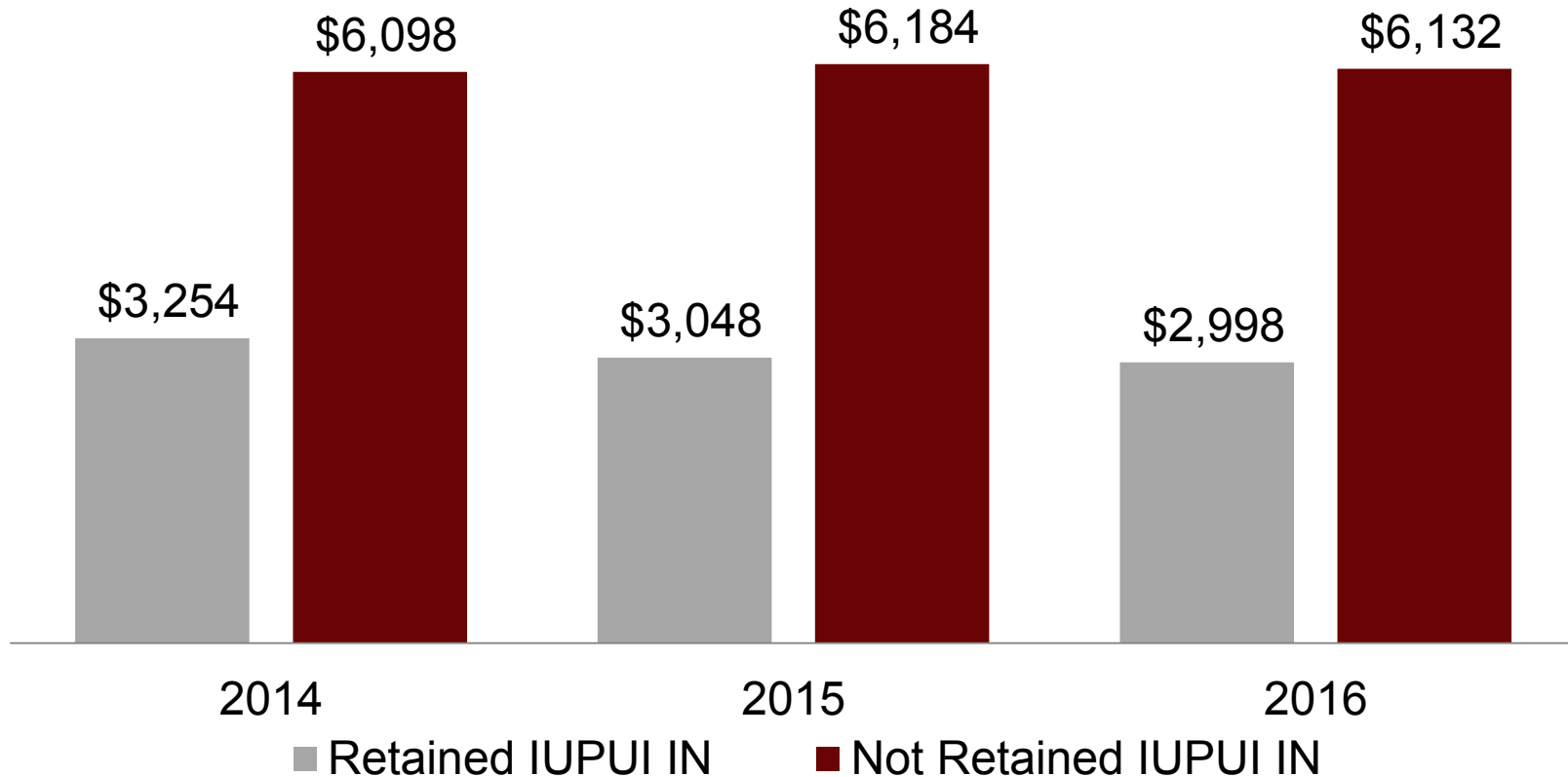


- 18 DEAP Students Received Housing Stipends in 2016 Retention Rate was 89% (Fall-to-Fall)
- 31 DEAP Students Received Housing Stipends in 2017 Retention Rate was 94% (Fall-to-Spring)
- DEAP students also participate in living-learning communities and Summer Bridge.



Annual Unmet Financial Need and One-Year Retention FT, FT Beginners

Total Unmet Financial Need Academic Year Common Dataset Definition



Retained and Not Retained Ns (2014=2162;1033), (2015=2236; 995), (2016=2365; 1038)



Unmet Financial Need Academic Year Fall 2016 IUPUI Indianapolis	N	% of All
No FAFSA on file	4092	21%
No Unmet Financial Need (FAFSA on file)	5120	26%
\$1 to \$1000 Unmet Need	827	4%
\$1001 to \$2000 Unmet Need	760	4%
\$2001 to \$3000 Unmet Need	711	4%
\$3001 to \$4000 Unmet Need	615	3%
\$4001 to \$5000 Unmet Need	744	4%
\$5001 to \$6000 Unmet Need	802	4%
\$6001 to \$7000 Unmet Need	880	4%
\$7001 to \$8000 Unmet Need	701	4%
\$8001 to \$9000 Unmet Need	623	3%
\$9001 to \$10,000 Unmet Need	511	3%
More Than \$10,000 Unmet Need	3196	16%
Grand Total	19582	100%



Recent IUPUI Student Experience Survey Spring 2018

- On average, **29%** of students Agreed or Strongly Agreed with statements that indicate they perceive that other people at IUPUI have a growth mindset.
- Faculty and staff do play a role in bolstering adaptive mindsets about intelligence—which can powerfully shape students’ own growth mindset and, in turn, their academic outcomes
- Examples of items:
 - “In general, most people at IUPUI believe that some students are smart, while others are not”
 - “In general, most people at IUPUI seem to believe that students have a certain amount of intelligence, and they really can’t do much to change it.”



N=769 Undergraduates (16%)



Bolstering Growth Mindset

- Faculty and staff do play a role in bolstering adaptive mindsets about intelligence—which can powerfully shape students' own growth mindset and, in turn, their academic outcomes
 - Provide support for learning
 - Set high standards and convey that we are motivated to help students attain them (journey taking together)
 - Give sense of purpose (applying learning experience to life and real world problems)
 - Foster growth and not fixed.
 - Set clear expectations and giving constructive, clear feedback on learning
 - Communicate that IUPUI is a place that student belongs (not just a place for other students)



Being Critical Consumers of Data

- Understand data and limitations.
- Not relying on single data point for telling whole story.
- Know data definitions.
- Understand of how data collected, sources, and research methods.
- Correlations does not mean causation.

Analytics

- Data analytics is the science of drawing insights from raw data sources. Many of the methods and techniques used in data analytics are automated into mechanical processes and algorithms that organize raw data for human decision making.
- Data analytics used to understand patterns of data that may otherwise be lost in the mass of information.
- Term used to describe statistical and mathematical data analysis that clusters, segments, scores and predicts the scenarios that are most likely to happen.

Predictive Analytics

- “A set of [business intelligence] technologies that uncovers relationships and patterns within large volumes of data that can be used to predict behavior and events”.
- “Predictive analytics is forward-looking, using past events to anticipate the future.”
 - van Barneveld, A., Arnold, K.E., & Campbell, J.P. (2012).



EAB

Education Advisory Board

- Combine technology, research, and consulting to help you **identify** your most at-risk populations, **coordinate** cross-campus resources so students can find the help they need, and **analyze** the data that informs your decision making.
- Provider of research, enterprise technology and data-enabled services for education institutions.
- Student Success Collaborative membership of more than 500 colleges and universities across the country working together to improve student outcomes and the student experience.

Overview

Success Progress

History

Class Info

Major Explorer

More ▾

Course Grade
D/F

7 ▾

Repeated
Courses

9 ▾

Withdrawn
Courses

8 ▾

Missed
Success Markers

5 ▾

Cumulative
GPA

2.38 ▾

Total Credits
Earned

152.00

Credit Completion %
at this Institution

74%

Predicted Risk Level

● Moderate

[View detail](#)

Moderate predicted likelihood of not graduating

This is an estimate based on the outcomes of students with similar attributes in your institution's historical student population. This is calculated using influencers relating to the student's academic performance, progress, program of study, pre-enrollment data, and other factors provided to EAB. Levels are based on thresholds set by your institution.

Science Undergraduate Psychology BS

Bachelor of Science
School of Science

Other Major(s)

Liberal Arts Undergraduate Sociology BA

Bachelor of Arts
School of Liberal Arts

STUDENT ID

ALTERNATE ID

CLASSIFICATION

Senior

MOST RECENT ENROLLMENT

Fall 2018

Big Data

- Billions of data points being generated every minute of every day by humans, computers and technological devices – creating a real-time digital footprint of our lives with every credit card swipe, phone use, Google search, Facebook post, and more.
- With availability of this ocean of data, how can we use it to better understand and our world and serve our needs.
- While college and universities doing cutting edge research on Big Data and educating data scientists, not using it as much as other industries to innovate our academic institutions.



“From the dawn of civilization to 2003, humans created five exabytes worth of data. As of 2013 humans produced this same amount of information every two minutes” (Miller & Chapin, 2013 as cited by Lane and Finsel, 2014)

Big Data and Analysis Methods

- Typically field of **Data Science** used for processing Big Data - Data Science field used to tackle big data. an umbrella term that encompasses data analytics, data mining, machine learning, and several other related disciplines.
- Involves gathering data from multiple sources and applies machine learning, predictive analytics, and sentiment analysis to extract critical information from the collected data sets.
- Machine learning used as practice of using algorithms to learn from data and then forecast future trends for that topic. Traditional machine learning software comprised of statistical analysis and predictive analysis that are used to spot patterns and catch hidden insights based on perceived data (used by Facebook).

Machine Learning and Algorithms

- Machine learning is a method of data analysis that automates analytical model building. It is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention. (SAS)
- An algorithm is a set of heuristics and calculations that creates a model from data. To create a model, the algorithm first analyzes the data you provide, looking for specific types of patterns or trends. The algorithm uses the results of this analysis over many iterations to find the optimal parameters for creating the mining model. These parameters are then applied across the entire data set to extract actionable patterns and detailed statistics.

Learning Analytics

Learning Analytics

- “The interpretation of a wide range of data produced by and gathered on behalf of students in order to assess academic progress, predict future performance, and spot potential issues.”
- “The use of predictive modeling and other advanced analytic techniques to help target instructional, curricular, and support resources to support the achievement of specific learning goals”
- Allows instructors to tailor educational opportunities to each student’s level of need and ability.
- Can be used assess curricula, programs, and institution
- Source: van Barneveld, A., Arnold, K.E., & Campbell, J.P. (2012).

Learning Management Systems: Canvas

- Grades on assignments and exams – progress
- Engagement (logging on and page views)
- Attendance
- Activity
- Chat rooms
- University-and course-level learning outcomes - scores on rubrics

E-Texts as Data Sources

- E-texts also provide powerful markup and interaction tools.
- Highlighting, shared notes, questions, and answers.
- Research found that higher engagement with e-texts (reading and highlighting) correlated with higher course grades (Abaci, Quick, and Morrone, 2017) .

IU Center for Learning Analytics and Student Success

Big data, predictive modeling, and learning analytics have rapidly emerged as some of the most robust and promising methods for ensuring that all students achieve their highest potential during their college years.

Sample Projects

Using Analytics to Evaluate Influences on Student Learning Outcomes in a GenEd Science Course (G131, Oceans & Our Global Environment): Phase II of an Analytics Approach Simon Brassell (Geological Sciences)

- Seeks to continue to utilize analytics on student demographics and grade records in combination with data on their performance in the GenEd NMS class G131 “Oceans and Our Global Environment” to assess how performance in the class and its range of assignments may be related to specific student characteristics.

Determinants of Student Attrition Michael Kaganovich (Economics)

- The proposed research will focus on the factors behind IU students’ decisions to make substantial changes in their studies at IU: to discontinue enrollment altogether (i.e., to drop out) or to switch from one major to another.

Ethics, Social Justice and Privacy

NEW YORK TIMES BESTSELLER



WEAPONS OF MATH DESTRUCTION



HOW BIG DATA INCREASES INEQUALITY
AND THREATENS DEMOCRACY

CATHY O'NEIL

A NEW YORK TIMES NOTABLE BOOK

Central Premise

- Predictive models and algorithms are increasingly the tools used to make decisions that affect people's lives ---where they go to school, whether they get a loan, how much they pay for health insurance, what type of sentence people receive when convicted of a crime.
- Decisions being made by mathematical models rather than humans.
- Ideally, the mathematical models are unbiased and lead to greater fairness. Not True!
- Many models used today are mysterious, unregulated, and uncontested with no feedback or correction mechanisms. Can be wrong.
- Algorithms if left unchecked essentially increase inequality creating "toxic cocktail for democracy."
- Used for harm rather than good.

WMDs

- Algorithms reinforce discrimination and widen inequality,
- Use people's fear and trust of mathematics to prevent them from asking questions.
- Rely on proxies (proxies are easier to manipulate than complicated reality they represent).
- “Algorithms that are important, secret and destructive”.
- Affect large numbers of people, are entirely opaque, and destroy lives.
- Models are opinions embedded in mathematics.

NOT WMDs

- Baseball
- Amazon
- Predictive modeling used to help provide resources for students

Examples of WMDs in Higher Education

- Drown the bunnies!
- US News and World Report Rankings (algorithms based on proxies and rankings become destiny).
- Marketing by for profit colleges (ads that pinpoint people in great need and sell them false and overpriced promises – predatory ads).
- Admissions decisions.

Recommendations

- Transparency (not relying on black boxes).
- Continuously update.
- Assumptions and conclusions clear.
- Rely on actual data rather than proxies.
- People being modeled understand the process and understand the models objective.
- Use to help rather than harm.

Data Security and Privacy

- Family Educational Rights and Privacy Act (FERPA)
- Institutional Review Boards (IRB) – generalizable research
- Stories of data violations
- Data Governance
- IUPUI Student Data Advisory Council and Faculty/Staff Data Advisory Council
- Ownership of data such as course evaluations and LMS/Canvas data
- Explaining use of data

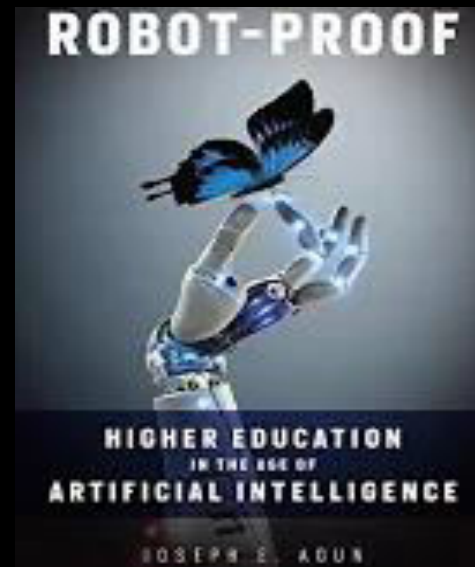
Data Integrity

- Data definitions and metadata
- Clear notes and sources
- Understanding limitations
- Explore prior to analyses and use
- Clear explanations of methods used to analyze or organize data

Conclusions

- Wealth of data available for decision making
- Value of data-based decision making
- Data literacy
- Ethical Use
- Theory-based methods

Final Thought



- In order for students to be productive citizens in a world in which lower skilled labor is being replaced by computers and robots, we need an educational shift focused and need to rebalance our curriculum to develop students with “creative mindsets and the mental elasticity to invent, discover, or create something valuable to society rather than concerned solely with “topping up students' minds with high-octane facts.”
- New skills: data literacy to manage the flow of big data, and technological literacy to know how their machines work, but human literacy, from the humanities, communication, and design, to function as a human being in a world populated with artificial intelligence advanced technologies.

• Aoun (2018), author of Robot- Proof Higher Education in the Age of Artificial Intelligence,

Questions!



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[IUPUI Data Link](#)



Contact us with questions or requests for information!



References and Resources

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Growth Mindset Resources with Live Links

- [Designing College for Everyone](#). Brief written by the College Transition Collaborative.
- [Leveraging Mindset Science to Design Educational Environments that Nurture People's Natural Drive to](#)
- [Designing Supportive Learning Environments](#). Video created by the Mindset Scholars Network.
- The New Science of Wise Psychological Interventions. Journal article by Gregory Walton, published in Current Directions in Psychological Science.
- [Social-Psychological Interventions in Education: They're Not Magic](#). Journal article by David Yeager and Gregory Walton, published in Review of Educational Research.
- [Broadening Participation in the Life Sciences with Social-Psychological Interventions](#). Journal article by Yoi Tibbetts, Judith Harackiewicz, Stacy Priniski, and Elizabeth Canning, published in CBE Life Sciences Education.