

SYLLABUS FOR F635 MARKET MICROSTRUCTURE, SPRING 2018

Professor:	Craig W. Holden
Office:	HH 6157
Office Hours:	Feel free to drop by any time!
Office Phone:	812-855-3383
E-Mail:	cholden@indiana.edu
Web site:	www.kelley.iu.edu/cholden
Career Resources:	www.kelley.iu.edu/cholden/CareerResources.htm

COURSE DESCRIPTION

Welcome to both the theory and empirical analysis of market microstructure! Market microstructure is a relatively young subdiscipline in finance, yet it has grown rapidly into one of the largest subdisciplines. It has had a profound impact both on the real world and on the academic profession. Indiana University has had a strong tradition over the last 25 years of dissertation research in market microstructure.

I have set three goals for students in this class:

1. Develop a fundamental knowledge of both the theory and empirical analysis of market microstructure,
2. Develop key modeling and empirical design skills by actively using them, and
3. Develop academic writing skills and presentation skills by actively using them.

MY TEACHING APPROACH

My approach to teaching involves three key features:

1. **Assignment Preparation.** For each class session, there are assigned readings. You are expected to read all of the assigned readings before class.
2. **Class Participation.** You are expected to be ready to lead the class discussion on any part of the assigned reading and to generally participate in the class discussion. Some of the time I will ask for volunteers to lead the class discussion and other times I will cold-call students to insure that everyone participates. This is an “active learning” approach, where students are the primary source of classroom learning and interaction.
3. **Learn By Doing.** The best way to learn how to do research is to actually do research. The best way to learn how to present your research to others is to actually present your research to others. Therefore, you are expected to do an original research paper and to do a class presentation of your research.

COURSE OUTLINE

PART I: EMPIRICAL ANALYSIS

<u>Session Theme and Topics</u>	<u>Assignment Preparation</u>
<u>(1.) Jan 9, Introduction</u> <ul style="list-style-type: none"> • Syllabus • Overview to Microstructure Data • Downloading TAQ Data using WRDS • Introduction to Market Microstructure 	An Overview of Microstructure Data, National Best Bid and Offer (NBBO).xlsx <u>Assignment:</u> F635 Assignment 1: WRDS Web-Form Downloading of Monthly TAQ Data, Due Next Class
<u>(2.) Jan 11, NBBO, TAQ, and Liquidity Measures</u> <ul style="list-style-type: none"> • NBBO Example • Using SAS to Access TAQ and Compute the NBBO and Liquidity Measures • Standard Measures of Liquidity 	NBBO Example, Holden-and-Jacobsen-Daily-TAQ-Code-2018-03-16.pdf, Holden, Jacobsen, and Subrahmanyam (2014), Pages 263-278 <u>Assignment:</u> F635 Assignment 2: Analyzing Daily TAQ or Monthly TAQ Data on the WRDS Cloud, Due Next Class
<u>(3.) Jan 16, Trade Typing</u> <ul style="list-style-type: none"> • Trade Typing • Timing Specifications 	Lee and Ready (1991), Henker and Wang (2006), Pages 162-170
<u>(4.) Jan 18, Liquidity Measurement Problems</u> <ul style="list-style-type: none"> • Liquidity Measurement Problems 	Holden and Jacobsen (2014), Holden and Jacobsen (2014) Presentation.ppt
<u>(5.) Jan 23, Developing Trends</u> <ul style="list-style-type: none"> • Equity Trading in the 21st Century 	Angel, Harris, and Spatt (2011), Angel, Harris, and Spatt (2011) Policy Issues.ppt
<u>(6.) Jan 25, The PIN and Hybrid Models</u> <ul style="list-style-type: none"> • The PIN Model • The Hybrid PIN-Kyle Model 	Easley, Kiefer, O'Hara, and Paperman (1996), Pages 1405-1422 , Back, Crotty, and Li (2016), Pages 1-10, 15-16, 20-25, Tables 1, 4, 5, 6, Figures 2, 4, 5, 6, 7
<u>(7.) Jan 30, Information Shares</u> <ul style="list-style-type: none"> • Price Discovery by Regional Exchanges • Price Discovery in Stock and Option Markets • Price Discovery in Stock, OTC Corporate Bond, and NYSE Corporate Bond Markets 	Hasbrouck (1995), Chakravarty, Gulen, and Mayhew (2004), Pages 1235, 1241-1246 , Holden, Mao, and Nam (2017), Pages
<u>(8.) Feb 1, Finnish Data and LOB Construction</u> <ul style="list-style-type: none"> • Sensation seeking and overconfidence • IQ and performance • Constructing the Limit Order Book 	Grinblatt and Keloharju (2009), Pages 549-569 , Grinblatt, Keloharju, and Linnainmaa (2012), Pages 339-351 , Kavajecz (1999), Pages 749-752
<u>(9.) Feb 6, Matched Samples and LOB and Call Markets</u> <ul style="list-style-type: none"> • Testing for Cost Differences • Live exercise: LOB and Call Markets 	Davies and Kim (2009), LOB and Call Markets.xlsx

<p>(10.) Feb 8, <u>Kickoff and Commonality</u></p> <ul style="list-style-type: none"> • Research and Communication Skills • Kickoff of the Original Research Paper • Commonality in Liquidity • A Global Perspective 	<p>Research and Communication Skills.docx, Chordia, Roll, and Subrahmanyam (2000), Pages 3-15, 24-26, Brockman, Chung, and Perignon (2009), Pages 851-863, 877</p>
<p>(11.) Feb 13, <u>Discussion of Student-Selected Articles</u></p>	
<p>(12.) Feb 15, <u>The Flash Crash</u></p> <ul style="list-style-type: none"> • The Flash Crash • The Impact of High Frequency Trading 	<p>Joint Final Report on the Flash Crash (2010), Pages 1-8, Flash Crash Reports (2010).pptx (PowerPoint slides), Kirilenko, Kyle, Samadi, and Tuzun (2017), Pages 967-979, Figures 4, 5, 6, 7, 9, 12</p>
<p>(13.) Feb 20, <u>Review Article</u></p> <ul style="list-style-type: none"> • The Empirical Analysis of Liquidity 	<p>Holden, Jacobsen, and Subrahmanyam (2014), 279-280, 289-296, 298-318</p>
<p>(14.) Feb 22 <u>Corporate Bonds</u></p> <ul style="list-style-type: none"> • Impact of TRACE on trading costs • Exchange vs. OTC trading 	<p>Bessembinder, Maxwell, and Venkataraman (2006), Pages 251-254, 257, 260-280, Biais and Green (2007), Pages 1-5, 17-29, 35-37, Fig. 1-7</p>
<p>(15.) Feb 27, <u>Options</u></p> <ul style="list-style-type: none"> • Determinants of the Options Bid-Ask Spread • Toward a National Market System 	<p>Goyenko, Ornathanalai, and Tang (2014), Pages 1-24, Tables 1-7, Figures 1-9, Battalio, Hatch, and Jennings (2004), Pages 933-936, 943-955</p>
<p>(16.) March 1, <u>Liquidity-adjusted CAPM</u></p> <ul style="list-style-type: none"> • World Price of Liquidity Risk • Do the LCAPM Predictions Hold? 	<p>Lee (2011), Pages 136-1562, <i>Critical Finance Review Request For Proposals</i>, Holden and Nam (2017), Pages 1-17, 28-33, 36-37</p>
<p>(17.) March 6, <u>Behavioral Empirics</u></p> <ul style="list-style-type: none"> • Buy-sell imbalances on and around round numbers • Trading in attention-grabbing stocks 	<p>Bhattacharya, Holden, and Jacobsen (2012), Barber and Odean (2008), Pages 785-789, 797, 800, 802, 804, 806</p>
<p>(18.) March 8, <u>Low-Frequency Liquidity Proxies</u></p> <ul style="list-style-type: none"> • Global Stock Liquidity • Liquidity in Commodities, Foreign Exchange, and Bonds 	<p>Fong, Holden, and Trzcinka (2017), Marshall, Nguyen, and Visaltanachoti (2012), Pages 599-600, 615, 617-618, 620, Karnaukh, Ranaldo, and Soderlind (2015), Pages 3073, 3077-3078, 3080, 3083, Schestag, Schuster, and Uhrig-Homburg (2016), Pages 1170, 1182, 1184, 1186-1187</p>
<p>Spring Break</p>	
<p>(19.) March 20, <u>Live Exercise and The Experimental Approach</u></p> <ul style="list-style-type: none"> • Live Exercise in Designing an Empirical Study • How Noise Trading Affects Markets 	<p>Handout on Live Exercise in Designing an Empirical Study, Bloomfield, O'Hara, and Saar (2009), Pages 2275-2296</p>
<p>(20.) March 22, <u>Trading Invariance</u></p> <ul style="list-style-type: none"> • Intraday Trading Invariance in the E-mini S&P 500 Futures Market 	<p>Andersen, Bondarenko, Kyle, and Obizhaeva (2016)</p>

PART II: THEORY

<u>Session Theme and Topics</u>	<u>Assignment Preparation</u>
(21.) <u>March 27, The Single-Period Kyle Model</u> <ul style="list-style-type: none"> The single-period model 	Kyle (1985), Pages 1315-1320
(22.) <u>March 29, The Multi-Period Kyle Model</u> <ul style="list-style-type: none"> The multiperiod-period model 	Kyle (1985), Pages 1320-1328, 1334-1335
(23.) <u>April 3, Kyle Extensions and Applications</u> <ul style="list-style-type: none"> Many informed traders Basket securities 	<u>Extension:</u> Holden and Subrahmanyam (1992), Pages 247-262 <u>Application:</u> Subrahmanyam (1991), Pages 17-33, 39 F635 Extentions of the Kyle Model
(24.) <u>April 5, Inventory Risk</u> <ul style="list-style-type: none"> Inventory risk Arbitrage trading 	Grossman and Miller (1988), Pages 617-619, 622-628 , Holden (1995), Pages 423-435
(25.) <u>April 10, Limit Order Models</u> <ul style="list-style-type: none"> Dynamic Limit Order Book Numerical Dynamic Limit Order Book 	Parlour (1998), Pages 789-800 , Goettler, Parlour, and Rajan (2005), Pages 2149-2161, 2165-2170
(26.) <u>April 12, Optimal Trading Strategy</u> <ul style="list-style-type: none"> A Theory of Optimal Institutional Trading 	Holden (2015)
(27.) <u>April 17, Research Paper Presentations</u> <ul style="list-style-type: none"> 23-Minute Presentations and 2 Minute Class Discussions 	
(28.) <u>April 19, Over-The-Counter (OTC) Markets</u> <ul style="list-style-type: none"> Six Imperfections, Including Search Auction versus Search in OTC 	Vayanos and Wang (2011), Pages 222-225, 230-231, 292-299 , Hendershott and Madhavan (2015), Pages 419-434
(29.) <u>April 24, Market Liquidity and Funding Liquidity</u> <ul style="list-style-type: none"> Market Liquidity and Funding Liquidity 	Brunnermeier and Pedersen (2009)
(30.) <u>April 26, Behavioral Theory</u> <ul style="list-style-type: none"> Live Exercise in Designing a Theoretical Study Overconfidence and Attribution Bias The Psychological Theory That Underlies Behavioral Finance 	Handout on Live Exercise in Designing a Theoretical Study, Daniel, Hirshleifer, Subrahmanyam (1998), Pages 1839-1855 , Barberis and Thaler (2002), Pages 1, 11-21
(31.) <u>April 30, Original Research Paper</u> <ul style="list-style-type: none"> Round 3 Original Research Paper and Response to the Referee is due at 11:00 p.m. 	

GRADING

1. Grading is done on a curve based on total points for the course. The following items are graded:

Project	Points	Percent
Assignment 1	25 points	5%
Assignment 2	25 points	5%
Class Participation in the First Half	100 points	20%
Class Participation in the Second Half	100 points	20%
Original Research Paper:		
• Presentation Quality	50 points	10%
• Academic Writing Quality . .	75 points	15%
• Substantive Quality	125 points	25%
Total Points	500 points	100.00%

2. I expect you to participate in the class discussion. I record class participation for each student immediately after class.

ARTICLE DISCUSSIONS

You are asked to lead two 25-minute class discussions while sitting in your chair (i.e., no PowerPoint) of a published or forthcoming article in market microstructure on February 13. The article must have been published in the years 2012 to the present or currently be forthcoming in a top-tier finance journal (JF, JFE, RFS, JFQA, or RF) or in the top microstructure field journal (*Journal of Financial Markets*).

25 minutes is a short amount of time. You need to focus on the big picture. You need to cover the overall motivation, key assumptions, and key results / intuitions. Don't get bogged down in the details and derivations. This is not a presentation, so PowerPoint is not permitted. Instead, you will lead the class discussion from your chair and I will show key article pages on the screen.

Article discussion sign-ups will begin on February 1 after class. Please supply a PDF file of the requested article in its final published form from the journal web site (not in its working paper form). Sign-ups will be first-come, first served. The PDF file of each selected article will be distributed to the entire class. Students are expected to give each selected article at least a 20 minute “quick read” prior to the class discussion. A quick read means completely reading the introduction and then selectively reading key parts, such as the assumptions, figures, propositions, data description, or tables.

ELECTRONIC RESOURCES

I have created a zip file with F635 class reading materials, data documentation, practitioner analysis (Credit Suisse, KOR, Rosenblatt, and Goldman Sach’s “Street Smart”), SAS programs, TORQ data, TORQ access programs, career resources, and my entire library of microstructure articles. This zip file can be downloaded from the **Files** link in **Canvas**.

ORIGINAL RESEARCH PAPER

You are to develop an original research paper following the three round process listed below.

Round 1. The writeup is due on Feb 23. Brainstorm two or three possible research ideas. For round 1, you should write-up each idea (limit of one page per idea) plus the pros and cons of each idea. Here are key questions to ponder about each of your research ideas:

- Why is this idea interesting (i.e., what is the motivation for it)?
- What possible *results* do you hope to obtain? Remember: *results* are what sell papers!
- Is the idea even feasibility to do (i.e., do you have access to all of the needed data)?
- How much time to you anticipate it will take? Research always takes longer than your ex-ante estimate!

Response 1. Drop by my office on the afternoon of Feb 26 or later. We will discuss the merits of each idea.

Round 2. Paper submission is due April 13 at 11:00 p.m. Do your research. Write up it up in the standard academic research paper format. The body of the paper (excluding the title page, appendices, tables, or figures) is limited to 12 double-spaced pages with normal size font and one-inch margins all around. Journal space is very limited, so it is a good habit to learn to write your papers with a very tight, efficient use of space.

Please keep the literature review brief (no more than one page of the introductory section) and focused on the papers that are the most directly relevant to your research. I want you to spend most of your time working on your new idea, rather than doing extensive background reading.

For empirical work, **keep the sample size small and manageable**. Microstructure datasets can be huge and there is limited time in the semester. Please spend most of your time analyzing a manageable sample, rather than getting bogged down in bulk processing a giant / unmanageable sample. Let me suggest viewing this project as a pilot study. If you get interesting results on a small scale and wish to pursue it, then you can expand the sample to full size when the course is over.

Submit your paper as a **PDF file** to the Round 2 Assignment at the Assignments link in Canvas. Your file will immediately be processed by the anti-plagiarism tool **Turnitin**. This tool will check your paper against all papers posted on the web and all prior papers submitted at IU and will produce a *similarity score* for your paper.

Class Presentation on April 17. Develop a 20 minute, PowerPoint presentation for the class, which will be followed by a short amount of time for audience questions. You should include the standard components of a research presentation: research question, motivation (i.e., why is this interesting?), hypotheses and data sources for empirical work, and results including key interpretations/intuitions. On the presentation date, please come to class a few minutes early and copy your presentation to the Desktop of the classroom computer.

Response 2. I will add comments on both the substance and exposition in your paper. I will send you an email that I have read your report and asking you to stop by my office. In my office I will provide additional explanation of my comments.

Round 3. Final version of the paper and the response to the referee are due April 30 at 11:00 p.m. Modify your paper to respond to my comments. Add any additional results and polish the exposition. Write a one-page "**response to the referee**" report explaining with terse bullet points how you have responded to my comments and what additional items have been added. Submit your final version and your response to the referee report as **PDF files** to cholden@indiana.edu (NOT via Canvas). Your grade for the research paper substance and academic writing will be based on the round 3 paper and response to the referee report.

AN OVERVIEW OF MICROSTRUCTURE DATA

WRDS: WRDS Databases, Ways to Use WRDS, The WRDS Microstructure Cloud Manual

Daily TAQ: Daily TAQ Trades Example, Daily TAQ Quotes Example NYSE, Daily TAQ Client Specification Version 3.0a

Monthly TAQ: (Monthly) TAQ User's Guide Version 3.31

NYSE Integrated Feed: <ftp://ftp.nyxdata.com/Historical Data Samples/TAQ NYSE Integrated Feed/>

TORQ: Hasbrouck (1992), Hasbrouck, Sofianos, and Sosebee (1993)

NASDAQ ITCH: NASDAQ TotalView-ITCH Version 4.1 Manual

NASDAQ High-Frequency Traders

SEC Disclosure Rules: Summary of New SEC Disclosure Rules, Example

Thomson Reuters Tick History (TRTH): Thomson Reuters Tick History (2010)

Datastream: Ince and Porter (2006)

TRACE: TRACE User Guide Version 2.0 2008, Dick-Nielsen (2013)

LiveVol: Historical Analysis of Options and Equity Data

Berkeley Options: Users Guide (1998), Rubinstein and Vijh (1987)

BOOKS ON MARKET MICROSTRUCTURE

O'Hara, M., 1998, Market Microstructure Theory, published by Blackwell Publishing Professional

Harris, L., 2003, Trading and Exchanges: Market for Practitioners, published by Oxford University Press

Hasbrouck, J., 2007, Empirical Market Microstructure: The Institutions, Economics, and Econometrics of Security Trading, published by Oxford University Press

Lhabitant, F. and F. Gregoriou, 2007, Stock Market Liquidity, published by John Wiley and Sons, Inc.

Vives, X., 2008, Information and Learning in Markets: The Impact of Market Microstructure, published by Princeton University Press

Kallunki, J., J. Broussard, and E. Boehmer, 2002, Using SAS in Financial Research, published by SAS Press.

Johnson, B., 2010, Algorithmic Trading & DMA, published by 4Myeloma Press

Teall, J., 2013, Financial Trading and Investing, published by Academic Press

[Foucault, T., Pagano, M., and Roell, A., 2013, Market Liquidity, Theory, Evidence, and Policy, published by Oxford University Press](#)

SURVEY ARTICLES ON MARKET MICROSTRUCTURE

Easley, D. and M. O'Hara, 1995, Market Microstructure, in the Handbook of Finance, edited by R.A. Jarrow, V. Maksimovic, and W. T. Ziemba, in the Handbooks in Operations Research and Management Science, North Holland Press.

[Calamia, A., 1999, Market Microstructure: Theory and Empirics, University of Rome working paper](#)

[Madhavan, A., 2000, Market Microstructure: A Survey, *Journal of Financial Markets* 3, 205-258.](#)

[Stoll, H., 2003, Market Microstructure, Handbook of the Economics of Finance, edited by G.M. Constantinides, M. Harris, and R. Stulz, Elsevier Science B.V.](#)

[Biais, B., L. Glosten, and C. Spatt, 2005, Market Microstructure: A Survey of Microfoundations, Empirical Results, and Policy Implications, *Journal of Financial Markets* 8, 217-264.](#)

[Amihud, Y., Mendelson, H., and Pedersen, L., 2006, Liquidity and Asset Prices, *Foundations and Trends in Finance* 1, 269-364.](#)

[Gould, M., M. Porter, S. Williams, M. McDonald, D. Fenn, and Howison, 2011, Limit Order Books, *Quantitative Finance*, arXiv:1012.0349v2](#)

[Vayanos, D. and Wang, J., 2012, Theories of Liquidity, *Foundations and Trends in Finance* 4, 221-317.](#)

[Jones, C., 2013, What Do We Know About High-Frequency Trading? Columbia University working paper.](#)

[Holden, C., S. Jacobsen, and A. Subrahmanyam, 2014, The Empirical Analysis of Liquidity, *Foundations and Trends in Finance* 8, 263-365.](#)

INTRO TO SAS PROGRAMMING

[The Little SAS Book, Fourth Edition, Lora Delwiche and Susan Slaughter, 2008, SAS Press.](#)

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[Angel, J., L. Harris, and C. Spatt, 2011, Equity Trading in the 21st Century, *Quarterly Journal of Finance* 1, 1-53.](#)

[Back, K., K. Crotty, and T. Li, 2016, Estimating Information Asymmetry in Securities Markets, Rice University working paper.](#)

[Barber B. and T. Odean, 2008, All That Glitters: The Effect of Attention and News on the Buying Behavior of Individual and Institutional Investors, *Review of Financial Studies*, 21, 785-818.](#)

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[Battalio, R., B. Hatch, and R. Jennings, 2004, Toward a National Market System Exist for U.S. Exchange-listed Equity Options, *Journal of Finance*, 59, 933-962.](#)

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[Bloomfield, R. M. O'Hara, and G. Saar, 2009, How Noise Trading Affects Markets: An Experimental Analysis, *Review of Financial Studies*, 22, 2275-2302.](#)

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[Marshall, B., N. Nguyen, and N. Visaltanachoti, 2012, Commodity Liquidity Measurement and Transaction Costs, *Review of Financial Studies* 25, 599-638.](#)

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[Vayanos D. and J. Wang, 2011, Theories of Liquidity, *Foundations and Trends in Finance* 6, 221-317.](#)

DOCTORAL PROGRAM LEARNING GOALS

F635 contributes to achieving the following doctoral program learning goals: (1) comprehensive and intensive disciplinary knowledge, (2) comprehensive and intensive knowledge of research methods, (3) communication of disciplinary research, and (4) evaluations of disciplinary research. The course teaches comprehensive and intensive disciplinary knowledge by teaching the key ideas in the theory and empirical analysis of market microstructure, such as adverse selection, inventory risk, order processing costs, limit order book dynamics, behavioral theory, commonality in liquidity, transparency, the liquidity-adjusted CAPM, linkage vs. fragmentation, etc. The course teaches comprehensive and intensive knowledge of research methods by teaching the key research methods in market microstructure, such as the NBBO, liquidity measures, trading typing, PIN, info shares, limit order book construction, matched samples, spread decomposition, analysis of order data, the experimental approach, etc. and by having student do their own original research paper and providing individual feedback on the substance of their paper. The course teaches the communication of

disciplinary research by having students present their own research to the class and by providing individual feedback on the academic writing quality of their paper. The course teaches evaluations of disciplinary research by discussing the strengths and weaknesses of each academic paper that we cover and by having each student lead a discussion of a recently published or forthcoming paper.

APPENDIX

Doctoral Program Learning Goals

Goal 1: Comprehensive and Intensive Disciplinary Knowledge

Students who earn a doctorate degree in business will be able to demonstrate a comprehensive and intensive knowledge of the theories, concepts, frameworks, empirical findings, and controversies in a chosen business discipline.

Goal 2: Comprehensive and Intensive Knowledge of Research Methods

Students who earn a doctorate degree in business will be able to demonstrate a comprehensive and intensive knowledge of the research methods and analytical techniques applicable to a chosen business discipline.

Goal 3: Communication of Disciplinary Research

Students who earn a doctorate degree in business will be able to design, conduct, and communicate – in both written and oral formats – original research that makes a substantial contribution to a selected business discipline.

Goal 4: Evaluations of Disciplinary Research

Students who earn a doctorate degree in business will be able to evaluate research ideas and completed research projects critically, assessing their conceptual and methodological soundness and importance of contribution to existing knowledge in the field.

Goal 5: Teaching

Students who earn a doctorate degree in business will be able to teach effectively in a selected discipline at the university level.

Title IX

As your instructor, one of my responsibilities is to create a positive learning environment for all students. Title IX and IU's Sexual Misconduct Policy prohibit sexual misconduct in any form, including sexual harassment, sexual assault, stalking, and dating and domestic violence. If you have experienced sexual misconduct, or know someone who has, the University can help.

If you are seeking help and would like to speak to someone confidentially, you can make an appointment with:

The Sexual Assault Crisis Services (SACS) at (812) 855-8900 (counseling services)
Confidential Victim Advocates (CVA) at (812) 856-2469 (advocacy and advice services)
IU Health Center at (812) 855-4011 (health and medical services)

It is also important that you know that Title IX and University policy require me to share any information brought to my attention about potential sexual misconduct, with the campus Deputy Title IX Coordinator or IU's Title IX Coordinator. In that event, those individuals will work to ensure that appropriate measures are taken and resources are made available. Protecting student privacy is of utmost concern, and information will only be shared with those that need to know to ensure the University can respond and assist.

I encourage you to visit stopsexualviolence.iu.edu to learn more.