ORIE Open House:
Introducing the Center for Engineering & Decision Analytics

J. Eric Bickel

Operations Research & Industrial Engineering
17 April 2017

Agenda

- 4:00 – 4:30 PM   Arrive and Cocktails

- 4:30 – 5:30 PM   Overview of ORIE & CEDA

- 5:30 – 6:30 PM   Reception and Student Poster Competition

- 6:30 – 7:00 PM   Announce Winner and Closing

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We have the following objectives for today's event:

Open House Objectives

1. (Re)Introduce you to the Operations Research & Industrial Engineering (ORIE) program at UT Austin

2. Increase the engagement between **you** and ORIE faculty and students

3. Share the exciting progress ORIE has made over the last three years

4. Seek your guidance for how we could better serve the needs of industry

5. Demonstrate the value your company could obtain through further engagement with and investment in UT Austin's ORIE program

We plan on hosting an advisory board meeting in late May to continue our discussions.

Thank you for attending!!

Thank you for your support!!

Sharon Wood
Dean
Cockrell School of Engineering

Rick Neptune
Chair
Department of Mechanical Engineering

Operations Research & Industrial Engineering (ORIE) is an *interdisciplinary* graduate program chartered by the UT Austin Graduate School.

The University of Texas at Austin
Cockrell School of Engineering

- History
  - Program began in 1967 wit
  - PhD in ORIE was authorized in 1995

- ORIE is a graduate program that spans the university
  - 13 faculty reside in three departments and two colleges, with plans to expand
  - **Students receive an MS or PhD in Operations Research & Industrial Engineering**
  - Concentrations in Decision Analytics, Optimization, and Stochastic Systems

The Department of Mechanical Engineering is charged with administering the ORIE program.

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Engineering Education and Research Center

ORIE Faculty

Name	Research Focus	PhD Institution
Francois Baccelli	Stochastic Systems	Politecnico di Torino
Ross Baldick	Optimization & Electric Power Systems	UC Berkeley
Jonathan Bard	Optimization and Scheduling	George Washington U.
Eric Bickel	Decision Analysis	Stanford University
Steve Boyles	Transportation Networks	U. of Texas at Austin
Constantine Caramanis	Optimization & Machine Learning	MIT
Ned Dimitrov	Computational Optimization	U. of Texas at Austin
Dragan Djurdjanovic	Manufacturing & Predictive Analytics	U. of Michigan
Grani Hanasusanto	Stochastic Optimization	Imperial College London
John Hasenbein	Stochastic Systems	Georgia Tech
Erhan Kutanoglu	Manufacturing and Service Logistics	Lehigh University
Ben Leibowicz	Systems Modeling and Economics	Stanford University
Evdokia Nikolova	Systems Analytics	MIT

The ORIE student body is highly analytical and well rounded.

- 78 graduate students (42 MS and 36 PhD)

- Average GRE Scores

  – Quantitative: 95th percentile (75% of students have perfect GRE Q scores)

  – Verbal: 70th percentile (25% of students above the 90th percentile)

- 75% of students have a 3.5 GPA or higher

- MS students complete their degree in 2 years

- PhD students complete their degree in 4-6 years, including MS (2 years)

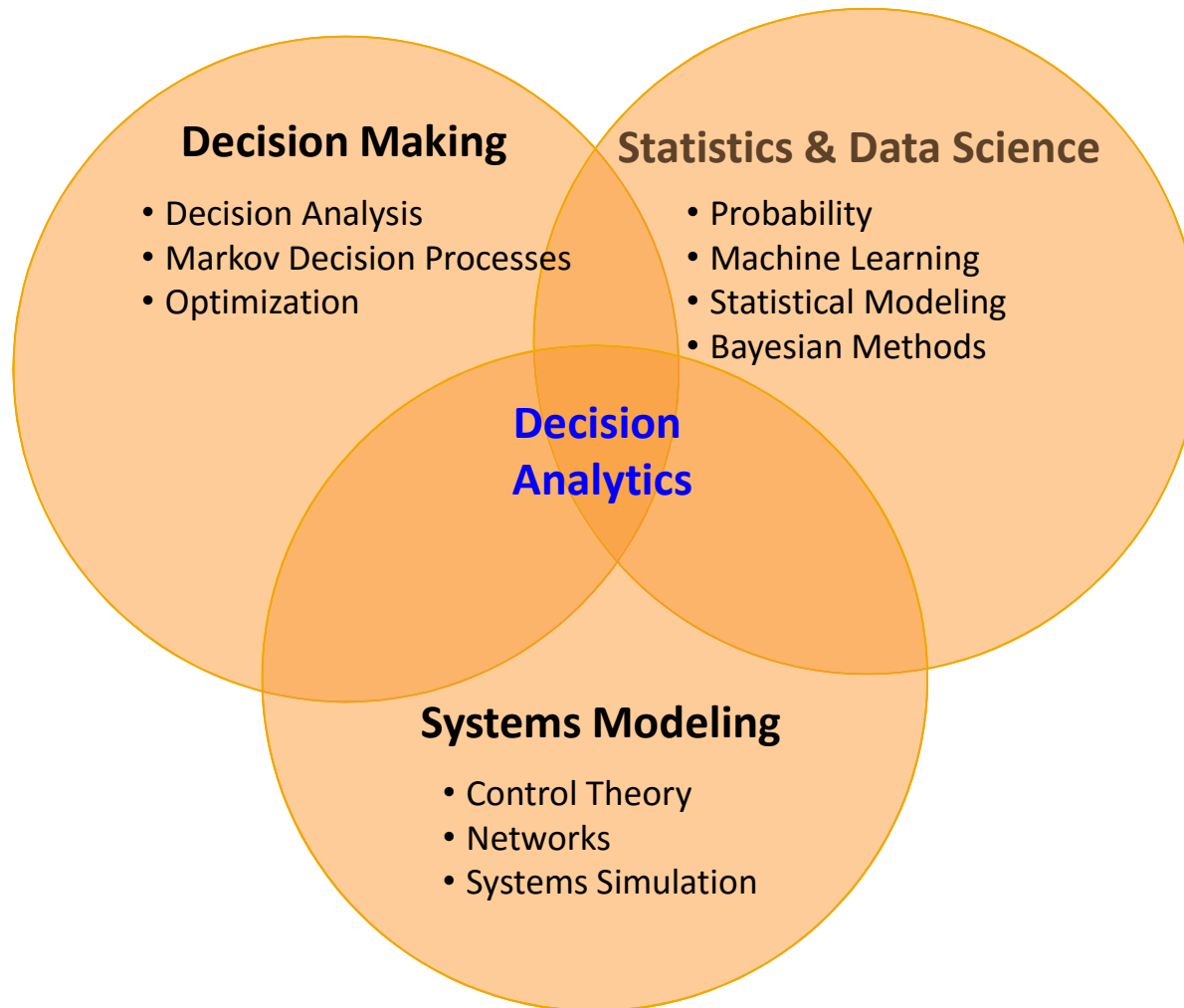**The majority of our students pursue careers in industry.**

We also offer an undergraduate certificate in Industrial and Systems Engineering.

- Engineering Economics

- Engineering Statistics

- Operations Research Models

- Production and Inventory Control

- Simulation

- Introduction to Industrial Engineering

Many undergraduate students are interested in industrial engineering and decision analytics.

ORIE students learn transferable skills and strong fundamentals that are applied to a wide range of areas.

Decision Making

- Decision Analysis
- Markov Decision Processes
- Optimization

Statistics & Data Science

- Probability
- Machine Learning
- Statistical Modeling
- Bayesian Methods

Decision Analytics

Systems Modeling

- Control Theory
- Networks
- Systems Simulation

Application Areas

Staff Scheduling
Production & Inventory Control
Manufacturing Systems
Logistics
Revenue Management
Transportation Networks
Electrical Power Systems
Healthcare Systems
Supply Chain Management
Online Marketing
Business Strategy
Public Policy
Cloud Computing
Disruption Management

In 2014 we recognized an opportunity to significantly improve the ranking of the ORIE program.

Source: ASEE college profiles (http://profiles.asee.org/).
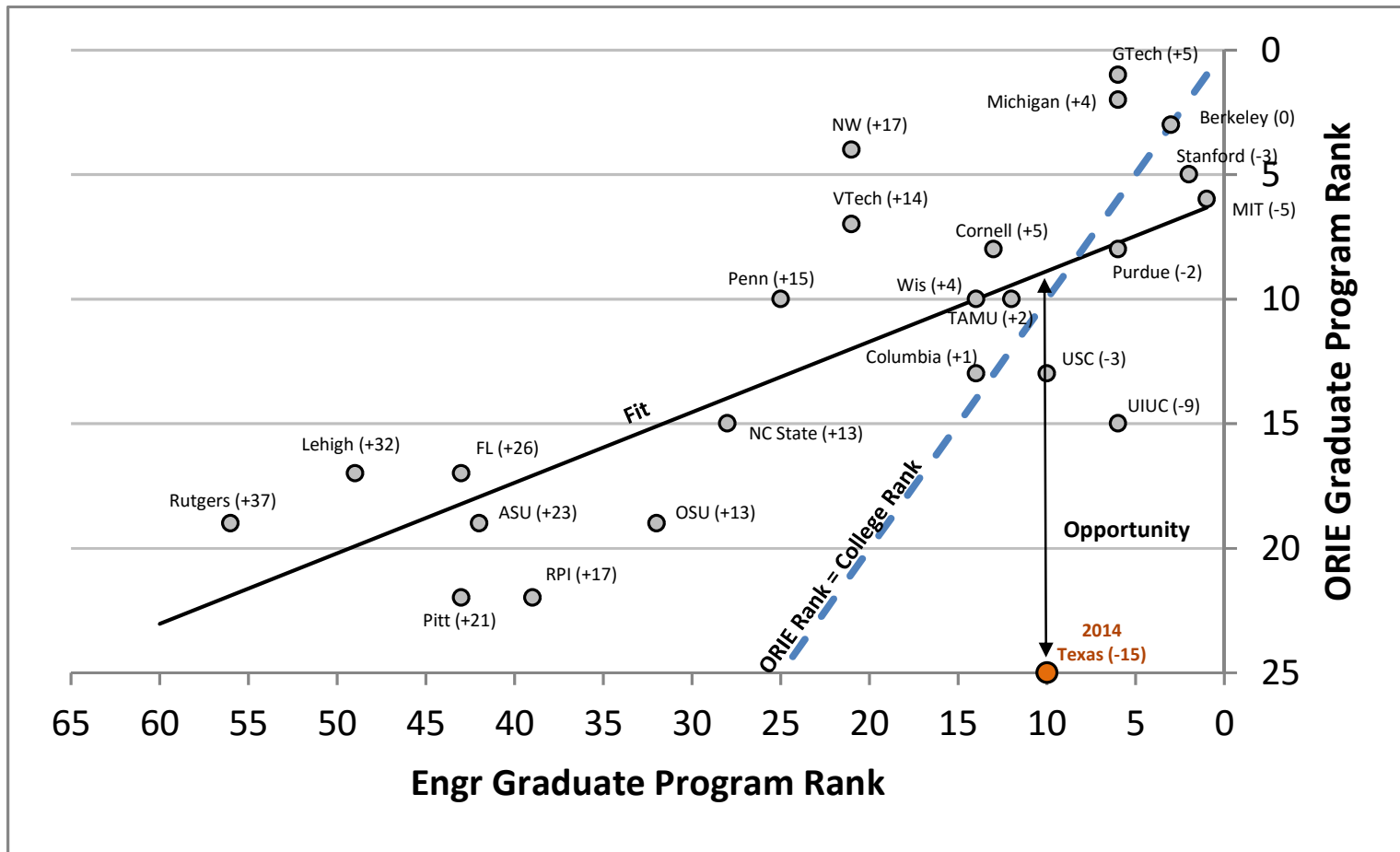
ORIE's Vision for 2020

The Graduate Program in Operations Research & Industrial Engineering strives to become a top-15 program by 2020. A stretch goal is to be among the top-10 programs by 2022.

We will produce highly-cited research results, place top students in academic positions and attract sufficient and high-quality funding.

Our course offerings will cover the breadth of operations research and industrial engineering theory and application. Students will be able to specialize in 3-4 areas of expertise.

We will be a catalyst for the analytics industry in Texas.

We will be recognized within the Cockrell School of Engineering as an important asset.

We will be recognized by the operations research community by winning the UPS **George D. Smith Prize** for effective and innovative preparation of students to be good practitioners of operations research.

To accomplish these goals we developed a strategic plan and have begun to implement it.

- ✓ Hire two new faculty members

- ✓ Added five faculty members

- ✓ Began redesigning our curriculum to leverage cross-listed courses

- ✓ Develop a standalone ORIE website (http://www.orie.utexas.edu/)

- ✓ Developed an ORIE newsletter that is sent to OR/IE department chairs

- ✓ Began attending OR and IE department head meetings

- Create an industrial affiliates program

We need your guidance and support to reach our goal of being a catalyst for the analytics industry in Texas.

Following our plan, our ranking has increased 8 spots in the last three years. You can be involved in the next step!

Source: ASEE college profiles (http://profiles.asee.org/).
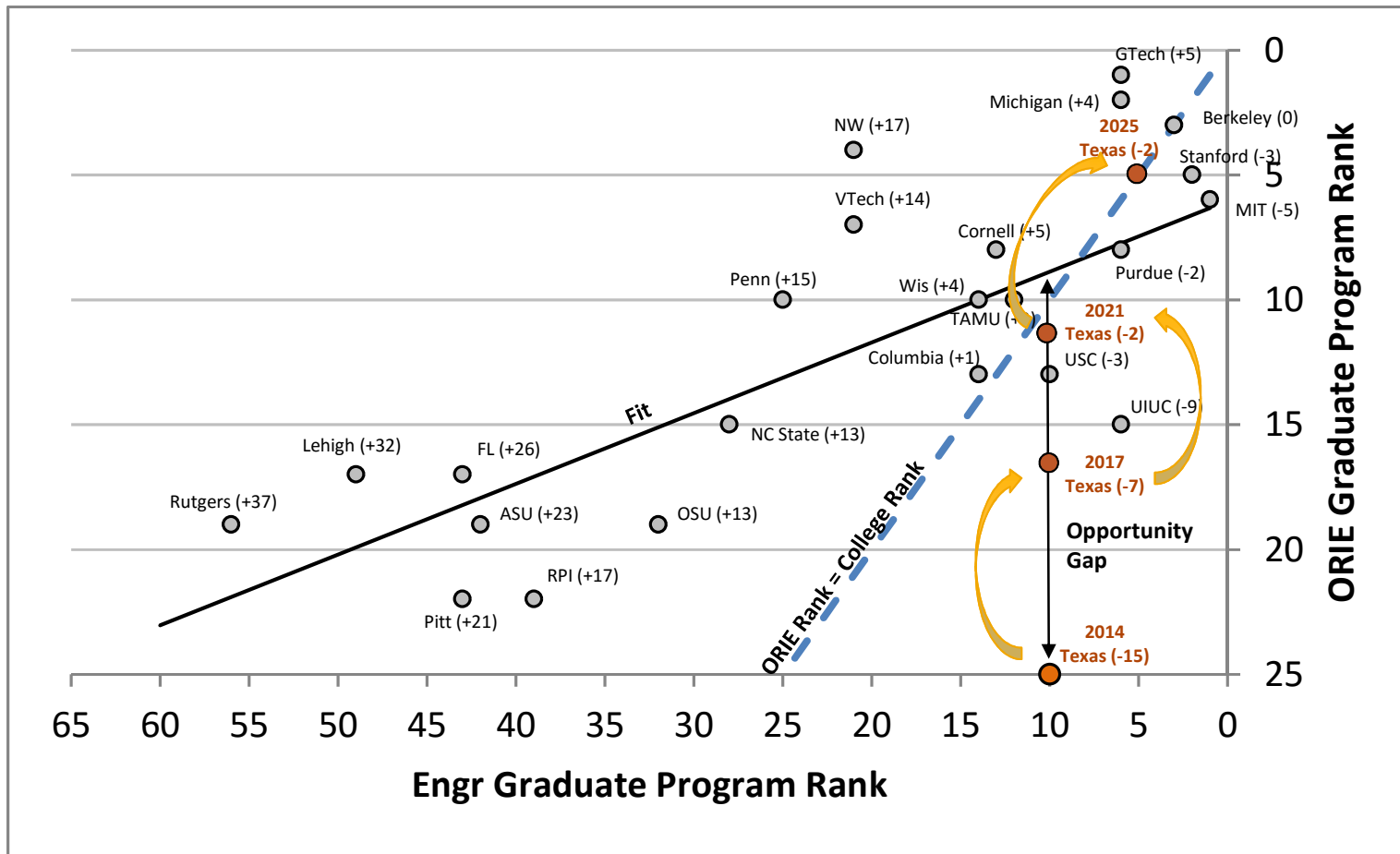
ORIE would like to create an industrial affiliates program.

Program Objectives

- Become the catalyst for the analytics industry in Texas

- Train students to work on a wide-range of important and challenging decision analytics problems, relevant to industry

- Ensure that our educational program is focused on industry needs

- Develop a pipeline of interesting research problems, leading to external funding

- Work collaboratively with industry to develop novel methods and solutions to important problems

- Develop the funding base needed to support a graduate program of the highest caliber

To accomplish these objectives, we are establishing

The Center for Engineering & Decision Analytics (CEDA)
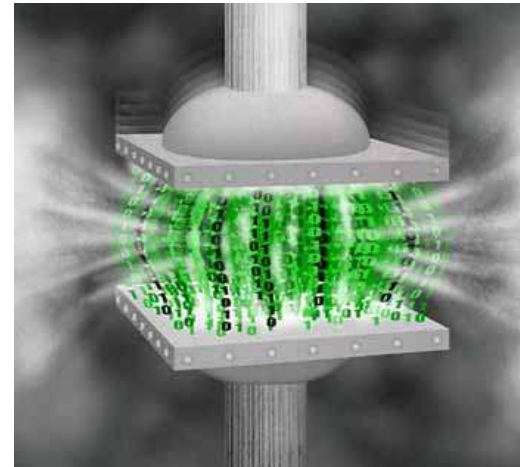
What is "decision analytics"?

Wikipedia defines "analytics" as the discovery, interpretation, and communication of meaningful patterns in data.

Why would we want to do that?   **Because we need to make a <u>decision</u> (addressing a business problem)!**

The view that if we "just squeeze the data hard enough the decisions will pop out" is not the way decision making works in industry—nor should it.

Time and resources are limited. We need to think carefully about what decisions we are trying to make, what our objectives are, and what information would help us make a high-quality decision. *How much is better data worth?*

Yet, this decision focus is missing from most discussions of analytics and nearly all academic analytics programs.

Operations Research & Industrial Engineering addresses the <u>whole</u> problem.

Decision Analytics

- Any decision has three components

  – What we can do

  – What we want

  – What we know (or don't know)

- Analytics may be necessary, but is not sufficient to make good decisions

- How will the analytics change our decision making?

- What is the **value** of the value of the data we are gathering or the analytics we are performing?

ORIE is the only field that addresses all these aspects of decision making.

ORIE Alumnus and Professor Win 2017 Franz Edelman Award for Achievement in Analytics!!

The Edelman Prize is the top prize that INFORMS (our professional society) awards for analytics and applied operations research!

Prorize (http://prorize.com/) won this award for the application of revenue management to the pricing of senior living communities.

Prorize was founded by Dr. Utku Yildirim (ORIE PhD student) and Dr. Ahmet Kuyumcu (ORIE Adjunct Professor).

In order to continue building and improving our program, we need additional resources.

- The ORIE faculty actively seek research grants from federal and state sources, but funding is very limited

- We have a long history of working with industry

- A graduate student costs about $50,000 per year

- Faculty on are nine-month appointments and actively seek summer support

CEDA Membership Model

Organizations actively participate in creating the hub for analytics in Texas by providing guidance, access to data/problems, and financial support.

These resources are used to improve the ORIE educational program and support graduate students through funded research projects.

Organizations benefit through access to students, relevant research results, marketing of their brand on campus, training of staff, and the creation of an analytics "hot bed" in Austin.

We are looking for partners that share our vision and are willing to help us build it.

CEDA Activities

Capstone Student Project

Through our "Applied Projects in ORIE" (APRIORI) course, you will work with a team of 3-5 graduate students to address an problems facing your company. One semester course.

CEDA Seminar Series

Weekly seminar series focused on cutting-edge analytics tools and methodologies. Falls and spring semester. Seminar live steamed and archived for CEDA members.

CEDA "Analytics in Action" Student Colloquium

(Bi-)Monthly evening seminar series led by the INFORMS student chapter. Industry professionals present their work or that of the their company. Engage directly with students, while enjoying pizza and soda! Schedule filled with CEDA members first.

Annual CEDA Showcase

One-day conference, with presentations by ORIE faculty, students, and CEDA members.

CEDA Research

Participate in research projects led by ORIE faculty. Engage directly on important research problems facing your company.

CEDA Resources and Other Benefits

CEDA Website

CEDA membership recognition. Access to portfolio of student CVs, profiles, and videos. Archived seminars and announcement of latest activities!

CEDA Research Website

Access to the latest CEDA research (papers, presentations, video summaries).

CEDA Fellowship

Make a three-year commitment and create a named fellowship. For example, the "ABC Fellowship in Analytics." Student receiving the fellowship will be listed as the "ABC Fellow".

We are open to other ideas!

CEDA Board Structure

CEDA Advisory Board (bi-annual meetings)

- Help guide ORIE's academic mission and program
- Engage with students and faculty
- Provide an industry perspective regarding needed skills and experiences
- Serve as a connection between your company and students
- Provide data for company-relevant problems

CEDA Research Steering Committee (annual meetings)

- Bring forward important problems facing your company
- Suggest research areas and themes
- Help ORIE faculty prioritize the distribution of CEDA funding and research areas
- Engage with faculty and students on research

CEDA Membership Levels

Benefit	Level 1 $50,000 per year	Level 2 $75,000 per year	Level 3 3 Year Commitment
CEDA Advisory Board and Research Steering Committee	■	■	■
Individual Student Research Project or APRIORI Capstone Project	■	■	■
Participate directly in CEDA research or student projects (provide data, advise students, frame projects)	■	■	■
Research-Support Website (Access to latest CEDA research and findings)	■	■	■
Bi-Annual CEDA Showcase (Research & Student Networking) and Other Networking/Recruiting Events	■	■	■
Member Recognition (Posting in ORIE Office, Website, Social Networking Sites)	■	■	■
Members-Only Website (Student CV Portfolio, Archived Seminars)	■	■	■
Sponsor Capstone Student Design Project		■	■
Sponsorship of CEDA Seminar Series and Live-Streaming and/or Archive of Seminar Series		■	■
Annual Invitation to Present in the "Analytics in Action" Student Colloquium		■	■
Company-Named Graduate Student Fellowship (e.g., "ABC Fellow")			■

We have worked closely with many companies over the last several years.

Ray Ellis
Well Technology Specialist
Statoil

Andrew Beck
Statoil Fellow
ORIE

Robert Hammond
Decision Analyst
Chevron

Former ORIE student

CEDA Roll-Out Plan

- Host an open house in April 2017 for member companies and potential member companies

- **Invite interested partners to CEDA Advisory Board meeting in May 2017.**

- Obtain three to five charter members by August 1, 2017.

- Secure three additional member companies by August 1, 2018.

- Grow program over the next three years to include at least 10 member companies with annual funding in excess of $500,000.

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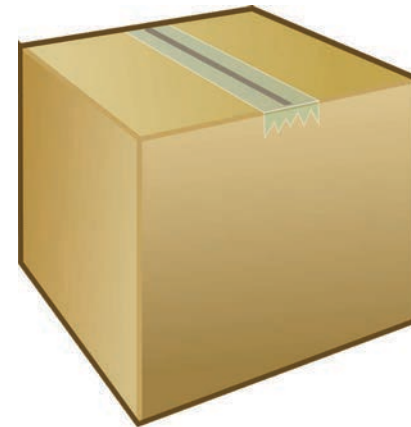
- 6:30 – 7:00 PM   Announce Winner and Closing

Student Poster Competition

- **Andrew Beck**, "Options Valuation in Unconventional Oil & Gas Wells"

- **Xi "Carol" Chen**, "Aedes Arbovirus Risk in Texas"

- **Can Gokalp**, "Robust Optimization with Decision Dependent Uncertainty"

- **Shreya Gupta**, "Improving Scheduling and Control of the OHTC Controller in Wafer Fab AMHS Systems"

- **Chris Hadlock**, "Johnson Quantile-Parameterized Distributions"

- **Keren "Kevin" Wang**, "Integrated Preventive Maintenance and Logistics Decision-Making and Its Extensions"

- **Deyi "Derek" Zhang,** "Bayesian Identification of Hidden Markov Models with Application to Condition-Based Monitoring"

- **Huidong Zhang**, "Assessment of Sensitivity of Zonal Isolation Risk to Changes in Design Parameters"

- **Alex Zolan**, "Decomposing and Bounding MIPs for Optimal Microgrid Design"

Judging Process

- Company representatives judge!

- You were given three poker chips when you checked in

- Each poster has a number

- You vote by placing one (or more) chips in the corresponding box

- We will tally the results at 6:30 PM and announce the winner!

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CEDA Next Steps

- We will be posting a pdf of this slide deck on the ORIE website.

- Please take a CEDA flyer with you!

- Take this back and socialize CEDA with your organization.

- Identify the appropriate decision maker and bring them to the first **CEDA Advisory Board meeting in May 2017.**

  – We will be happy to answer your questions at that time.

Thank you to ...

- Barbara Thompson, Adrienne Lee, Cherie Rachel, and Bliss Angerman for helping us to plan and deliver this open house!

- Informs Student Chapter & Shreya Gupta!

- Thank you to our wonderful students for presenting their research results

- Thank you to Dean Wood and Rick Neptune for their support

- **And, special thanks to our company representatives for your attending and your support. We hope we will be able to work closely together in the future.**

Thank you for attending!!!

J. Eric Bickel
Associate Professor & Director
Operations Research & Industrial Engineering
Petroleum & Geosystems Engineering
Engineering Management

Past-President, *INFORMS Decision Analysis Society*
Fellow, *Society of Decision Professionals*

Research Focus
- Decision analytics
- Value of information
- Forecasting and assessment

Application Areas
- Strategic decision making
- Oil & gas
- Energy and climate policy
- Sports

Teaching
- Decision Analysis I & II
- Applied Probability
- Engineering Economics
- Probability and Statistics

Other
- Director at Strategic Decisions Group
- Practicing decision analyst for over 25 years (joined SDG in 1995)
- Academic Director, *Strategic Decision & Risk Management Certificate*, McCombs School of Business

Jonathan F. Bard
Professor
Operations Research & Industrial Engineering

VP Publications, *INFORMS*
Past VP Publications *IIE*
Fellow, *INFORMS & IIE*

Research Focus
- Decomposition techniques for MIPs
- Analysis & design of manufacturing systems
- Personnel planning & scheduling
- Hierarchical optimization

Application Areas
- Healthcare delivery
- Airline scheduling
- Internal & external logistics
- Semiconductor processing planning

Teaching
- Linear and Integer Programming
- Project Management
- Engineering Economics
- Healthcare Models

Other
- Over 30 years of consulting for such organizations as FedEx, TI, Kroger, CareSys
- Founding Editor of *IIE Transaction on Operations Engineering*
- Honorary doctorate from TUM
- Fulbright Scholar

Ross Baldick
Professor and Leland Barclay Fellow
Electrical and Computer Engineering
Operations Research & Industrial Engineering

Research Focus
- Power systems
- Optimization

Application Areas
- Power system economics
- Electricity network interdiction and cascading outage analysis
- Electric transmission planning
- Renewable integration and economics
- Electric vehicles and grid

Teaching
- Power system analysis
- Smart grid
- Electricity markets
- Optimization

Other
- Former chair of System Economics sub-committee of IEEE Power and Energy Society
- Organizer of non-technical short courses on electricity markets

Stephen D. Boyles
Associate Professor
Operations Research & Industrial Engineering
Civil, Architectural & Environmental Engineering
Transportation Engineering

Research Focus
- Transportation network analysis
- Traffic simulation
- Network algorithms

Application Areas
- Emerging vehicle technologies
- Transportation planning and forecasting
- Real-time traffic management
- Parking management

Teaching
- Transportation Network Analysis
- Dynamic Traffic Assignment
- Optimization Techniques for Transportation
- Probability and Statistics

Other
- Chair of Transit, Freight and Logistics Subcommittee of Transportation Research Board
- Past chair of Intelligent Transportation Systems special interest group of INFORMS

Dragan Djurdjanovic
Associate Professor
Operations Research & Industrial Engineering
Department of Mechanical Engineering

Fellow of the Int'l. Soc. for Eng. Asset Management (ISEAM)
Past-Chair, ASME Tech. Committee on Quality & Reliability

Research Focus
- Modeling, Monitoring and Control of Complex Systems
- Control of Multistage Processes
- Simulations Based Optimization

Application Areas
- Semiconductor manufacturing
- Equipment monitoring
- Maintenance and operations optimization
- Human body data analytics

Teaching
- Time-Series Modeling and Analysis
- Statistical Methods in Manufacturing
- Dynamic Systems and Control
- Programming and Computational Methods

Other
- Director of the NSF I-UCRC on Intelligent Maintenance Systems at UT Austin
- Assoc. Editor of IEEE Trans. on Automation Science and Eng., IEEE Trans. on Industrial Informatics and ASME Jour. of Manuf. Science and Eng.

Grani A. Hanasusanto
Assistant Professor
Operations Research & Industrial Engineering

Research Focus
- Decision-making under uncertainty
- Stochastic and robust optimization
- Convex optimization

Teaching
- Optimization Under Uncertainty
- Applied Stochastic Processes

Application Areas
- Operations management
- Energy systems
- Machine learning and data analytics
- Control theory and engineering

John J. Hasenbein
Professor
Operations Research & Industrial Engineering

Past-President, INFORMS Applied Probability
Society

Research Focus
- Markov Decision Processes
- Queueing Networks: Design & Control
- Fluid Approximations
- Rare Event Modeling

Application Areas
- Semiconductor Wafer Fabrication
- Revenue Management
- Predictive Maintenance
- Risk Models in Nuclear Power
- Tennis & Volleyball Strategy
- Cell Phone Virus Detection

Teaching
- Stochastic Processes
- Applied Probability
- Queueing Theory
- Markov Decision Processes
- Systems Simulation
- Probability and Statistics

Erhan Kutanoglu
Associate Professor
Operations Research & Industrial Engineering
Department of Mechanical Engineering
Cockrell School of Engineering

Research Focus
- Applied Optimization
- Integer Programming
- Discrete Modeling and Optimization
- Network Design

Application Areas
- Integrated Supply Chain and Logistics Management
- Post-sales Service Logistics
- Semiconductor Manufacturing
- Transportation and Freight Logistics
- Cloud Computing

Teaching
- Integer Programming
- Scheduling Theory and Applications
- Production and Inventory Control
- Logistics Analytics

Other
- Advisor, Consultant or Collaborator in Industry Projects for over 20 years
- Past collaborations include AMD, Caterpillar, IBM, NXP

Benjamin D. Leibowicz
Assistant Professor
Operations Research & Industrial Engineering
Mechanical Engineering

Research Focus
- Integrated systems modeling
- Engineering-economic analysis
- Optimization and game theory

Application Areas
- Energy and climate policy
- Technology transitions
- Sustainability
- Clean energy technology innovation

Teaching
- Systems Modeling
- Applied Probability
- Engineering Finance

Other
- Joined UT Austin in August 2016
- PhD and MS in Management Science and Engineering from Stanford
- BA in Physics from Harvard
- Was a research fellow at IIASA in Austria while in graduate school