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Research Opportunities in Operations Research (RO in OR)

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What is Operations Research?

Mathematical modeling of complex systems with the goal of optimal decision-making (the “Science of Decision-making”).

Methodologies

- * Discrete Optimization**
- * Applied Probability**

Motivated by Actual Problems

- * Aviation Security**
- * Pediatric Vaccines and Immunization**
- * Healthcare Scheduling**





What is Operations Research?

Crosses between Theory and AI

Theory

- * Algorithms
- * Networks
- * Integer Programming
- * Discrete Optimization

AI

- * Heuristics
- * Data Analytics
- * Statistics





Research Activities

Ph.D. Topics

Data-driven decision-making under uncertainty

BIG Data analytics using discrete optimization

B&B strategies for DOPs





Data-driven decision-making under uncertainty

On-line Optimization: Stochastic Sequential Assignment Problems

- * Optimal decision-making under uncertainty
- * Applied probability
- * Graph theory

Applications: Aviation security, Ebola screening





BIG Data analytics using discrete optimization

Balance Optimization Subset Selection (BOSS) for Causal Inference Experiments

- * Exploit Discrete Optimization Structure within a Statistical Framework
- * Making sense of BIG DATA

Applications: Medicine, social sciences, sports, marketing, ...





B&B Strategies for DOPs

Cyclic Best First Search

- * Novel Approach to search the solution space for NP-hard DOPs.
- * Using cycling across level sets / contours in the search tree

Applications: Medical scheduling, service systems scheduling, ...





Bed Time Research

- * Most of my Ph.D. students get involved in a secondary activity.
- * Typically involves applied research, advising UG students, web development.
- * Results in publications and conference presentations.
- * Many of these activities have drawn the attention of the media (local, national)





Sample of Bed Time Research Topics

- * **Laws that Ban Cell Phones While Driving and Accident Rates**
- * **Obesity, Transportation, and Energy**
- * **Trends in Murder Rates in the United States**
- * **NCAA Basketball “March Madness” Bracket Analysis**
- * **United States Presidential Election Prediction**



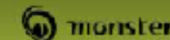
Obesity, Transportation, and Energy

Can a treadmill help you save on gas? - The Driver's Seat - MSNBC.com

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Can a treadmill help you save at the pump?

Experts see better ways than slimming to beat high gasoline prices

By Roland Jones

Associate editor
MSNBC

Updated: 10:01 a.m. CT Nov 1, 2006



Roland Jones
Associate editor

- Profile
- E-mail

A new study that received a lot of publicity last week contends that Americans are wasting billions of dollars every year on gasoline because of the growing size of their waistslines.

Yes, the laws of physics still apply when it comes to driving — the fatter you are, the fatter your fuel bills will be, as it takes more power to propel you and your car down the road. But before you jump onto a treadmill to

CNBC VIDEO



c_obese_gas_061027.asf

Launch

A weighty issue?

Oct. 27: Sheldon Jacobson, a researcher at the

<http://www.msnbc.msn.com/id/15447601/>

8/23/2007



NCAA Basketball “March Madness” Bracket Analysis

- * Statistical analysis of seed trends
- * Probabilistic assessment of seed combinations

BracketOdds

<http://bracketodds.cs.illinois.edu>



United States Presidential Election Prediction (electionanalytics.cs.illinois.edu)

- Statistical analysis of state polling data
- Probabilistic analysis of electoral college vote distributions
- Analyzed the 2014 midterm Senate races
- Analyzed the 2016 Presidential and Senate races





Screening for Ebola at Airports

MSNBC: Weekends with Alex Witt 10/5/14 **Ebola fears spur calls for airport screenings**

Aviation Security Analyst Sheldon Jacobson talks with Alex Witt about his **recent op-ed in The Washington Post** that makes the case for enhanced security measures in airports to help thwart an Ebola outbreak in the U.S. – specifically screening the virus like they do for terrorists.





CBC News, Toronto, Canada, 11 October 2014

CBC News | Oct 11, 2014

Expert on Ebola airport screening

Aviation security expert Sheldon H Jacobson on new measures to screen travellers for Ebola at airports





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