# Stanford



# **Ross Shachter**

Associate Professor of Management Science and Engineering

# CONTACT INFORMATION

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# Bio

# BIO

Ross Shachter joined Stanford's faculty directly after receiving his Ph.D. degree. His doctoral dissertation developed a method for purchasing an expert's forecast that encourages accurate revelation of the expert's beliefs as probabilities. Since then his research has focused on the representation, manipulation, and analysis of uncertainty and probabilistic reasoning in decision systems. He developed many of the fundamental methods for analyzing Bayesian belief networks and influence diagrams, and showed how they could be used by people and machines to communicate complex relationships among uncertain quantities, decisions, and objectives. His current research focuses on modeling uncertain processes and decision#making, including medical policy, meta-analysis, and intelligent systems. He has analyzed cancer screening processes for bladder and breast cancer and vaccination strategies for HIV and Helicobacter pylori.

His research interests include:

Influence diagram knowledge representation and solution; Intelligent decision systems; Medical decision analysis; Decision analysis fundamentals; and Planning under uncertainty

# ACADEMIC APPOINTMENTS

- Associate Professor, Management Science and Engineering
- Faculty Affiliate, Institute for Human-Centered Artificial Intelligence (HAI)
- Member, Stanford Cancer Institute
- Affiliate, Stanford Woods Institute for the Environment

# ADMINISTRATIVE APPOINTMENTS

• John A. and Cynthia Fry Gunn University Fellow in Undergraduate Education, VPUE, (2021-2026)

#### BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Board Chair, Association for Uncertainty in Artificial Intelligence (2018 2020)
- Treasurer, Association for Uncertainty in Artificial Intelligence (2016 2018)
- Secretary, Association for Uncertainty in Artificial Intelligence (2014 2016)

#### **PROFESSIONAL EDUCATION**

- BS, Massachusetts Institute of Technology, Management (1976)
- PhD, UC Berkeley, Operations Research (1982)

### **Research & Scholarship**

#### CURRENT RESEARCH AND SCHOLARLY INTERESTS

Prof. Shachter joined Stanford's faculty directly after receiving his Ph.D. degree. His doctoral dissertation developed a method for purchasing an expert's forecast that encourages accurate revelation of the expert's beliefs as probabilities. Since then his research has focused on the representation, manipulation, and analysis of uncertainty and probabilistic reasoning in decision systems. As part of this work, he developed the DAVID influence diagram processing system for the Macintosh. He has developed models scheduling patients for cancer follow-up, and analyzing vaccination strategies for HIV and Helobacter pylori.

He has worked closely with many students in Bioinformatics, where he held a courtesy appointment. He has been active in the Conference on Uncertainty in Artificial Intelligence, is a full member of INFORMS and its Decision Analysis Society. He has held memberships in the American Association for Artificial Intelligence, the Society for Medical Decision Making, and the Society for Decision Professionals.

# Teaching

#### COURSES

#### 2023-24

- Decision Analysis Seminar: MS&E 454 (Aut, Win, Spr)
- Discrete Probability Concepts And Models: MS&E 20 (Sum)
- Foundations of Decision Analysis: MS&E 252 (Win)
- Introduction to Decision Analysis: MS&E 152 (Spr)
- Probabilistic Analysis: MS&E 220 (Aut)

#### 2022-23

- Decision Analysis Seminar: MS&E 454 (Aut, Win, Spr)
- Discrete Probability Concepts And Models: MS&E 20 (Sum)
- Foundations of Decision Analysis: MS&E 252 (Win)
- Influence Diagrams and Probabilistics Networks: MS&E 355 (Spr)
- Introduction to Decision Analysis: MS&E 152 (Spr)
- Probabilistic Analysis: MS&E 220 (Aut)

#### 2021-22

- Foundations of Decision Analysis: MS&E 252 (Win)
- Influence Diagrams and Probabilistics Networks: MS&E 355 (Spr)
- Introduction to Decision Analysis: MS&E 152 (Spr)

• Probabilistic Analysis: MS&E 220 (Aut, Sum)

#### 2020-21

- Decision Analysis I: Foundations of Decision Analysis: MS&E 252 (Win)
- Decision Analysis Seminar: MS&E 454 (Aut, Win, Spr)
- Introduction to Decision Analysis: MS&E 152 (Spr)
- Probabilistic Analysis: MS&E 220 (Aut)

#### STANFORD ADVISEES

#### Doctoral Dissertation Reader (AC)

Marc Eskew

#### Doctoral Dissertation Advisor (AC)

Samuel Liu, Fernando Rodriguez Silva Santisteban

#### Master's Program Advisor

Joshua Chan, Prithvi Krishnarao, Andrew Lin, Anastasiia Malenko, Ramesh Ramasubramanian, Karina Santoso, Scott Simmons, Benjamin Zaidel

#### Doctoral (Program)

Korina Arpasova, Andrew Couch, Morgan Knowlton

#### **GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS**

• Biomedical Informatics (Phd Program)

# **Publications**

#### PUBLICATIONS

- Uncovering interpretable potential confounders in electronic medical records. *Nature communications* Zeng, J., Gensheimer, M. F., Rubin, D. L., Athey, S., Shachter, R. D. 2022; 13 (1): 1014
- Why Did They Do That? *Probabilistic and Causal Inference: The Works of Judea Pearl* Shachter, R., Heckerman, D. Association for Computing Machinery.2022: 805-812
- Natural Language Processing to Identify Cancer Treatments With Electronic Medical Records. *JCO clinical cancer informatics* Zeng, J., Banerjee, I., Henry, A. S., Wood, D. J., Shachter, R. D., Gensheimer, M. F., Rubin, D. L. 2021; 5: 379–93
- A Probabilistic Model to Support Radiologists' Classification Decisions in Mammography Practice *MEDICAL DECISION MAKING* Zeng, J., Gimenez, F., Burnside, E. S., Rubin, D. L., Shachter, R. 2019; 39 (3): 208–16
- Prophylactic Fixation Can Be Cost-effective in Preventing a Contralateral Bisphosphonate-associated Femur Fracture CLINICAL ORTHOPAEDICS AND RELATED RESEARCH

   Event State Contralateral Displayer LA

Jiang, S. Y., Kaufman, D. J., Chien, B. Y., Longoria, M., Shachter, R., Bishop, J. A. 2019; 477 (3): 480–90

- A Web-based Decision Tool to Estimate Subarachnoid Hemorrhage Risk in Emergency Department Patients *Cureus* Manella, H., Sivasankar, S., Perry, J., Pfeil, S., Senyak, J., Shachter, R., Govindarajan, P. 2018; 10 (1)
- Dynamic Strategy for Personalized Medicine: An Application to Metastatic Breast Cancer. *Journal of biomedical informatics* Chen, X., Shachter, R., Kurian, A., Rubin, D.

2017

- Defense Science Board Summer Study on Autonomy
- David, R., Nielsen, P., et al

Office of the Under Secretary of Defense for Acquisition, Technology and Logistics. Washington, DC. 2016 107

- Decisions and Dependence in Influence Diagrams Proceedings of Machine Learning Research Shachter, R. D.
   2016; 52: 462-473
- Association of Care Practices with Suicide Attempts in US Veterans Prescribed Opioid Medications for Chronic Pain Management JOURNAL OF GENERAL INTERNAL MEDICINE

Im, J. J., Shachter, R. D., Oliva, E. M., Henderson, P. T., Paik, M. C., Trafton, J. A. 2015; 30 (7): 979-991

- Complexity of the Exact Solution to the Test Sequencing Problem *Thirty-First Conference on Uncertainty in Artificial Intelligence* Liu, W., Shachter, R. D. edited by Heskes, T., Meila, M. AUAI.2015: 494–503
- Toward cost-effective staffing mixes for Veterans Affairs substance use disorder treatment programs. *BMC health services research* Im, J. J., Shachter, R. D., Finney, J. W., Trafton, J. A. 2015; 15 (1): 515-?
- Complex Operational Decision Making in Networked Systems of Humans and Machines: A Multidisciplinary Approach edited by ISBN 978-0-309-30770-3 102 pages 8.5 x 11 PAPERBACK (2014) Committee on Integrating Humans, Machines and Networks, A. National Academies Press.2014
- Approximate Kalman Filter QLearning for Continuous StateSpace MDPs. Proceedings of the Twenty-Ninth Conference on Uncertainty In Artificial Intelligence

AUAI.2013

- Formulating Asymmetric Decision Problems as Decision Circuits DECISION ANALYSIS Bhattacharjya, D., Shachter, R. D.
   2012; 9 (2): 138-145
- Backtracking for More Efficient Large Scale Dynamic Programming. Proceedings of the Eleventh International Conference on Machine Learning and Applications, Boca Raton, FL

2012

- Strictly Proper Mechanisms with Cooperating Players. Proceedings of the Twenty-Seventh Conference on Uncertainty in Artificial Intelligence AUAI.2011
- Dynamic programming in influence diagrams with decision circuits. Proceedings of the Twenty-Sixth Conference on Uncertainty in Artificial Intelligence AUAI.2010

 Pearl Causality and the Value of Control. Heuristics, Probability, and Causality: A Tribute to Judea Pearl Shachter, R., D., Heckerman, D., E.
 edited by Dechter, R., Geffner, H., Halpern, J., Y.
 College Publications..2010: 431–447

• Solving influence diagrams: exact algorithms. Wiley Encyclopedia of Operations Research and Management Science. Wiley.

Shachter, R., Bhattacharjya, D. edited by Cochran, J., J. 2010

• Three new sensitivity analysis methods for influence diagrams. Proceedings of the Twenty-Sixth Conference on Uncertainty in Artificial Intelligence AUAI.2010

- Cost-Effectiveness of a Potential Prophylactic Helicobacter pylori Vaccine in the United States *JOURNAL OF INFECTIOUS DISEASES* Rupnow, M. F., Chang, A. H., Shachter, R. D., Owens, D. K., Parsonnet, J. 2009; 200 (8): 1311-1317
- Are Patients Getting the oGisto in Risk Communication? Patient Understanding of Prognosis in Breast Cancer Treatment JOURNAL OF CANCER EDUCATION

Hutton, D. W., Belkora, J. K., Shachter, R. D., Moore, D. H. 2009; 24 (3): 194-199

- How can economic schemes curtail the increasing sex ratio at birth in China? *DEMOGRAPHIC RESEARCH* Bhattacharjya, D., Sudarshan, A., Tuljapurkar, S., Shachter, R., Feldman, M. 2008; 19: 1831-1850
- How can economic schemes curtail the increasing sex ratio at birth in China? *Demographic research* Bhattacharjya, D., Sudarshan, A., Tuljapurkar, S., Shachter, R., Feldman, M. 2008; 19 (54): 1831-1850
- Sensitivity analysis in decision circuits. Proceedings of the Twenty-Fourth Conference on Uncertainty in Artificial Intelligence
- Evaluating influence diagrams with decision circuits. Proceedings of the Twenty-Third Conference on Uncertainty in Artificial Intelligence AUAL2007
- Model Building with Belief Networks and Influence Diagrams. Advances in Decision Analysis: From Foundations to Applications Shachter, R., D. edited by Edwards, W., Ralph, J., Miles, F.

Cambridge University Press. 2007: 177–201

• Bayesian network to predict breast cancer risk of mammographic microcalcifications and reduce number of benign biopsy results: Initial experience *RADIOLOGY* 

Burnside, E. S., Rubin, D. L., Fine, J. P., Shachter, R. D., Sisney, G. A., Leung, W. K. 2006; 240 (3): 666-673

• Value of quantitative D-dimer assays in identifying pulmonary embolism: Implications from a sequential decision model ACADEMIC EMERGENCY MEDICINE

Duriseti, R. S., Shachter, R. D., Brandeau, M. L. 2006; 13 (7): 755-766

• Individualizing generic decision models using assessments as evidence JOURNAL OF BIOMEDICAL INFORMATICS

Scott, G. C., Shachter, R. D. 2005; 38 (4): 281-297

• Influence Diagrams for Team Decision Analysis. Decision Analysis Detwarasiti, A., Shachter, R., D.

2005; 2 (4): 207-228

• Individualizing Generic Decision Models Using Assessments as Evidence. Journal of Biomedical Informatics

Scott, G., Shachter, R. 2005; 4 (38): 281-29

• A probabilistic expert system that provides automated mammographic-histologic correlation: Initial experience 103rd Annual Meeting of the American-Roentgen-Ray-Society

Burnside, E. S., Rubin, D. L., Shachter, R. D., Sohlich, R. E., Sickles, E. A. AMER ROENTGEN RAY SOC.2004: 481–88

• Using a Bayesian network to predict the probability and type of breast cancer represented by microcalcifications on mammography 11th World Congress on Medical Informatics

Burnside, E. S., Rubin, D. L., Shachter, R. D. I O S PRESS.2004: 13–17

- The Cost Effectiveness of Partially Effective HIV Vaccines. Operations Research and Health Care Owens, D., Edwards, D., Cavallaro, J., Shachter, R. edited by Brandeau, M., Sainfort, F., Pierskalla, W. Kluwer..2004: 403–418
- A Bayesian Network to Assist Mammography Interpretation. Operations Research and Health Care Rubin, D., Burnsie, E., Shachter, R.
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  Burnside, E. S., Rubin, D. L., Shachter, R. D.
  ELSEVIER SCIENCE BV.2004: 1021–1026
- Statistics and causal inference: A review Discussion *TEST* Fienberg, S. E., Haviland, A. M., Heckerman, D., Shachter, R., Kadane, J. B., Moral, S., Pearl, J. 2003; 12 (2): 319-345
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- AAAI.2002
- Costs and benefits of imperfect HIV vaccines: Implications for vaccine development and use 14th Conference on Quantitative Evaluation of HIV Prvention Programs

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- Second Opinion: A framework for using decision models to automate & individualize interactive patient decision support aids Scott, G. C., Shachter, R., Lenert, L. A. BMJ PUBLISHING GROUP.2001: 833–833
- Using background knowledge to speed reinforcement learning in physical agents. Proceedings of the Fifth International Conference on Machine Learning 2001
- Using decision models to automate & individualize interactive patient-oriented decision support aids

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- Helicobacter pylori vaccine development and use: A cost-effectiveness analysis using the institute of medicine methodology *HELICOBACTER* Rupnow, M. F., Owens, D. K., Shachter, R., Parsonnet, J. 1999; 4 (4): 272-280
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- A dynamic HIV-transmission model for evaluating the costs and benefits of vaccine programs *INTERFACES* Edwards, D. M., Shachter, R. D., Owens, D. K. 1998; 28 (3): 144-166
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- Learning from What You Don't Observe. Uncertainty in Artificial Intelligence: Proceedings of the Fourteenth Conference Peot, M. A., Shachter, R. D. 1998
- Representation and analysis of medical decision problems with influence diagrams *MEDICAL DECISION MAKING* Owens, D. K., Shachter, R. D., Nease, R. F. 1997; 17 (3): 241-262
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- Decision theoretic foundations for causal reasoning *JOURNAL OF ARTIFICIAL INTELLIGENCE RESEARCH* Heckerman, D., Shachter, R. 1995; 3: 405-430
- A Definition and Graphical Representation for Causality. Uncertainty in Artificial Intelligence: Proceedings of the Eleventh Conference Heckerman, D. E., Shachter, R. D. 1995
- Decision-Theoretic Foundations for Causal Reasoning. *Journal of Artificial Intelligence Research* Heckerman, D., Shachter, R., D. 1995; 3: 405-430
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- A PHYSICIAN-BASED ARCHITECTURE FOR THE CONSTRUCTION AND USE OF STATISTICAL-MODELS METHODS OF INFORMATION IN MEDICINE

Lehmann, H. P., Shachter, R. D. 1994; 33 (4): 423-432

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- A method for the dynamic selection of models under time constraints. Selecting Models from Data: Artificial Intelligence and Statistics Rutledge, G., Shachter, R., D. edited by Cheeseman, P., Oldford, R., W. New York: Springer-Verlag..1994: 79–88
- A Decision-Based View of Causality. Heckerman, D., E., Shachter, R., D. 1994
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  Azevedo-Filho, A., Shachter, R., D.
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- Global Conditioning for Probabilistic Inference in Belief Networks. Shachter, R., D., Andersen, S., K., Szolovits, P. 1994
- End-User Construction of Influence Diagrams for Bayesian Statistics: Lehmann, H., P., Shachter, R., D. 1993
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- Using Potential Influence Diagrams for Probabilistic Inference and Decision Making: Shachter, R., D., Ndilikilikesha, P., M. 1993
- Mixtures of Gaussians and Minimum Relative Entropy Techniques for Modeling Continuous Uncertainties.
  Poland, W., B., Shachter, R., D.
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- Patient-Specific Explanation in Models of Chronic Disease. *AI in Medicine* Jimison, H., B., Fagan, L., M., Shachter, R., D., Shortliffe, E., H. 1992; 3 (4): 191-205
- Structural Controllability and Observability in Influence Diagrams. Chan, B., Y., Shachter, R., D. 1992
- Meta-Analysis by the Confidence Profile Method: The Statistical Synthesis of Evidence. Eddy, D., M., Hasselblad, V., Shachter, R. Boston: Academic Press..1992
- Representation of Preferences in Decision Support Systems. *Comput Biomed Res* Farr, B., R., Shachter, R., D. 1992; 25 (4): 324-335
- EVALUATION OF NONLINEAR OPTIMIZATION FOR SCHEDULING OF FOLLOW-UP CYSTOSCOPIES TO DETECT RECURRENT BLADDER-CANCER MEDICAL DECISION MAKING

Kent, D. L., NEASE, R. A., Sox, H. C., Shortliffe, L. D., Shachter, R. 1991; 11 (4): 240-248

• FUSION AND PROPAGATION WITH MULTIPLE OBSERVATIONS IN BELIEF NETWORKS ARTIFICIAL INTELLIGENCE Peot, M. A., Shachter, R. D.

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• Representation of preferences in decision-support systems. Proceedings / the ... Annual Symposium on Computer Application [sic] in Medical Care. Symposium on Computer Applications in Medical Care

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• AN ORDERED EXAMINATION OF INFLUENCE DIAGRAMS NETWORKS

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• DYNAMIC-PROGRAMMING AND INFLUENCE DIAGRAMS IEEE TRANSACTIONS ON SYSTEMS MAN AND CYBERNETICS TATMAN, J. A., Shachter, R. D.

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• Simulation Approaches to General Probabilistic Inference on Belief Networks. Uncertainty in Artificial Intelligence

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• Evidence Absorption and Propagation through Evidence Reversals. Uncertainty in Artificial Intelligence Shachter, R., D.

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• An Influence Diagram Approach to Medical Technology Assessment. Influence Diagrams, Belief Nets, and Decision Analysis Shachter, R., D., Eddy, D., M., Hasselblad, V. edited by Oliver, R., M., Smith, J., Q.

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• A Linear Approximation Method for Probabilistic Inference. Uncertainty in Artificial Intelligence

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- Dynamic Programming and Influence Diagrams. *IEEE Transactions on Systems, Man and Cybernetics* Tatman, J., A., Shachter, R., D. 1990; 2 (20): 365-379
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- Symbolic Probabilistic Inference in Belief Networks. Shachter, R., D., D'Ambrosio, B., Del Favero, B., A. 1990
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- Uncertainty in Artificial Intelligence 4. Shachter, R., D., Levitt, T., S., Lemmer, J., F., Kanal, L., N. Amsterdam: North-Holland. 1990
- A Bayesian method for synthesizing evidence. The Confidence Profile Method. International journal of technology assessment in health care Eddy, D. M., Hasselblad, V., Shachter, R. 1990; 6 (1): 31-55
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- Efficient Inference on Generalized Fault Diagrams. Uncertainty in Artificial Intelligence Shachter, R., D., Bertrand, L., J. edited by Kanal, L., N., Levitt, T., S., Lemmer, J., F. Amsterdam: North-Holland..1989: 325–332
- Simulation Approaches to General Probabilistic Inference on Belief Networks Shachter, R., D., Peot, M. 1989
- Evidence Absorption and Propagation through Evidence Reversals. Shachter, R., D. 1989
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- DECISION-THEORY FOR RETROSPECTIVE JUDGEMENTS OF DECISIONS Yu, A., Kent, D. L., HIGGINS, M. C., Mazur, D. J., Sox, H. C., Evans, P. A., Shachter, R. D., Fujimura, I., Howard, R. A.

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Kelly, F. P., Hand, D. J., Thatcher, A. R., Smith, J. Q., Critchley, F., Smith, A. F., Hilden, J., Kendall, W. S., Cooper, G. F., Dawid, A. P., Dempster, A. P., Almond, R. G., Dubois, et al 1988; 50 (2): 194-224

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