

## Changhwa Lee

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INTERESTS	Mechanism and Information Design, Industrial Organization, Algorithmic Fairness
PROFESSIONAL APPOINTMENTS	Lecturer (Assistant Professor), University of Bristol, 2023-present Research Affiliate, Group for Research in Applied Economics, 2022-present Postdoctoral Associate, Simon Business School, University of Rochester, 2022-2023
EDUCATION	Ph.D., Economics, <a href="#">University of Pennsylvania</a> , 2022 B.A., Economics, <a href="#">Sogang University</a> , Highest Distinction, 2014
RESEARCH WORKS	Lee C., <i>“Optimal Recommender System Design,”</i> Working Paper Lee C. with S. Kominers, P. Dworczak and M. Reuter, <i>“Optimal Membership Design,”</i> Working Paper Lee C. with M. Pai and R. Vohra, <i>“Outcome Tests for Policies,”</i> Working Paper Lee C. with C. Jung, S. Kannan, M. Pai, A. Roth and R. Vohra, <i>“Moment Multicalibration for Uncertainty Estimation,”</i> COLT 2021 Lee C. with C. Jung, S. Kannan, M. Pai, A. Roth and R. Vohra, <i>“Fair Prediction with Endogenous Behavior,”</i> EC 2020 Lee C., <i>“Fair Algorithms in the Hands of Unfair Humans: How a Fair Algorithm Can Make the Outcomes Unfairer,”</i> Work in Progress
PRESENTATIONS	2023: University of Rochester, Indiana University Bloomington, University of Essex. 2022: University of Wisconsin-Madison, University of Rochester, University of North Carolina at Chapel Hill, Purdue University, University of Bristol, National University of Singapore, Bonn University, Mannheim University, CERGE-EI, International Industrial Organization Conference, Analysis Group, Compass Lexecon, INFORMS, Econometric Society, Marketplace Innovation Workshop. 2021: NBER Decentralization: Mechanism Design for Vulnerable Populations. 2020: ACM Conference on Economics and Computation. 2019: Pennsylvania Economic Theory Conference. 2016: Economics Joint Conference of Korea.
REFEREES	AER Insight, Management Science.
HONORS AND AWARDS	Summers-Weintraub Fellowship in Economics. 2021 Received for being an outstanding fourth or fifth year theory, macroeconomics or international economics student. Sidney Weintraub Memorial Fellowship in Economics 2020 Received for being an outstanding third or fourth year theory student. Excellence in the Third Year Paper, University of Pennsylvania 2019 Received the highest grade for the third year paper evaluation. Lawrence Robbins Prize, University of Pennsylvania 2017 Ranked first in 2017 Preliminary Exams. Fellowship, University of Pennsylvania 2016 - 2021 Albatross Full Fellowship, Sogang University 2014 - 2015 Summa Cum Laude, Sogang University 2014 Ranked first among 63 School of Economics graduates Departmental Honors, Sogang University 2014 Kwanjeong Foundation Scholarship, Kwanjeong Foundation 2013 - 2014 Merit-based Full Scholarship, Sogang University 2009, 2010, 2012 Top 1% Academic Achievement Award, Sogang University 2009

RESEARCH ASSISTANCE	Prof. Rakesh Vohra and Prof. Aaron Roth	2019 - 2020
	Prof. Annie Liang	2019
	Prof. Ashley Swanson and Prof. Matthew Grennan	2018 - 2020
	Prof. George Mailath	2018
	Prof. Jungmin Lee	2014 - 2015
TEACHING EXPERIENCE	Main Instructor, Intermediate Microeconomics (Undergraduate)	2024
	Created and taught a course for games of incomplete information.	
	TA, Introduction to Economics (Undergraduate), Prof. Anne Duchene	2021
	Head TA, Advanced Game Theory (Undergraduate), Prof. Yuichi Yamamoto	2019
	Head TA, Graduate Game Theory (Graduate), Prof. Yuichi Yamamoto	2018
	Head TA, Advanced Game Theory (Undergraduate), Prof. Yuichi Yamamoto	2018
	TA, Graduate Game Theory (Graduate), Prof. George Mailath	2017
MILITARY SERVICE	Sergeant	2010 - 2012
COMPUTER SKILLS	MATLAB, STATA, R, Mathematica, $\text{\LaTeX}$	
LANGUAGES	English (Fluent), Korean (Native)	
RESEARCH PAPERS WITH ABSTRACTS	<i>“Optimal Recommender System Design”</i>	
	Presented at: University of Essex, University of Wisconsin-Madison, University of Rochester, University of North Carolina at Chapel Hill, Purdue University, Indiana University Bloomington, University of Bristol, International Industrial Organization Conference, INFORMS, Econometric Society, Marketplace Innovation Workshop.	
	An intermediary knows about a consumer’s preference better than the consumer himself. The intermediary designs and commits to a recommendations rule and a transfer rule to maximize the revenue it can collect from the sellers, while persuading the consumer to take the recommended action. The revenue maximizing recommendations rule is characterized by recommending the largest non-negative virtual surplus adjusted for the <i>cost of persuasion</i> , and can be implemented via a handicap auction. Allowing the intermediary to use additional information about sellers’ private information reduces information rent the intermediary pays to sellers and increases the intermediary’s revenue. Additional information, however, may increase or decrease consumer surplus and sellers’ profits. Sufficient conditions for additional information to increase or decrease consumer surplus and sellers’ profits are provided. These results provide a theoretical foundation for when the intermediary should be allowed to collect and use data about sellers.	
	<i>“Optimal Membership Design”</i> with Scott Kominers, Piotr Dworczak and Marco Reuter.	
	Many allocation problems can be recast as designing membership. The defining feature of membership as an economic good is that its value depends on who is a member. We introduce a framework for optimal membership design by combining an otherwise standard mechanism-design model with allocative externalities that depend flexibly on agents’ observable and unobservable characteristics. Our main technical result characterizes how the optimal mechanism depends on the pattern of externalities. Specifically, we show how the number of distinct membership tiers—differing in prices and potentially involving rationing—is increasing in the complexity of the externalities. This insight may help explain a number of mechanisms used in practice to sell membership goods, including artists charging below-market-clearing prices for concert tickets, heterogeneous pricing tiers for access to digital communities, the use of vesting and free allocation in the distribution of network tokens, and certain admission procedures used by colleges concerned about the diversity of the student body.	
	<i>“Outcome Test for Policies”</i> with Mallesh Pai and Rakesh Vohra.	

Presented at: *EC 2020, NBER Decentralization: Mechanism Design for Vulnerable Populations 2021.*

The marginal outcomes test (Becker (2010)) has become the ‘go to test’ of (un-)fairness/ disparate impact of a classification/ allocation rule. We consider settings with two key properties: (1) the underlying attribute of the agent being classified is strategically chosen by the agent, and (2) the adjudicator/ institution commits to a rule/ policy, taking into account strategizing by the agent. In this setting we show the outcome test is mis-specified: the optimal rule will result in indifferent marginal outcomes across demographics. We show instead that in this setting, the optimal rule equates average outcomes across groups. This basic insight is robust to underlying assumptions about (partial) commitment and payoff structure.

*“Moment Multicalibration for Uncertainty Estimation”* with Christopher Jung, Sampath Kannan, Mallesh Pai, Aaron Roth and Rakesh Vohra

Presented at: *COLT 2021*

We show how to achieve the notion of “multicalibration” from Hébert-Johnson et al. [2018] not just for means, but also for variances and other higher moments. Informally, it means that we can find regression functions which, given a data point, can make point predictions not just for the expectation of its label, but for higher moments of its label distribution as well-and those predictions match the true distribution quantities when averaged not just over the population as a whole, but also when averaged over an enormous number of finely defined subgroups. It yields a principled way to estimate the uncertainty of predictions on many different subgroups-and to diagnose potential sources of unfairness in the predictive power of features across subgroups. As an application, we show that our moment estimates can be used to derive marginal prediction intervals that are simultaneously valid as averaged over all of the (sufficiently large) subgroups for which moment multicalibration has been obtained.

*“Fair Prediction with Endogenous Behavior”* with Christopher Jung, Sampath Kannan, Mallesh Pai, Aaron Roth and Rakesh Vohra.

Presented at: *EC 2020*

There is increasing regulatory interest in whether machine learning algorithms deployed in consequential domains (e.g. in criminal justice) treat different demographic groups “fairly.” However, there are several proposed notions of fairness, typically mutually incompatible. Using criminal justice as an example, we study a model in which society chooses an incarceration rule. Agents of different demographic groups differ in their outside options (e.g. opportunity for legal employment) and decide whether to commit crimes. We show that equalizing type I and type II errors across groups is consistent with the goal of minimizing the overall crime rate; other popular notions of fairness are not.

*“Fair Algorithms in the Hands of Unfair Humans: How a Fair Algorithm Can Make the Outcomes Unfairer”*

Predictive algorithms are increasingly promoted as a way to reduce group disparities that come from human discretion. Often predictive algorithms do not operate on their own, but interact with human decision makers. Empirical findings suggest that group disparities may get amplified in such an environment even when the predictive algorithms themselves are unbiased across the groups. We study a decision maker who may acquire information at a cost before making a decision, and how the difference in his decisions across the groups changes before and after an introduction of a fair algorithm. We find that group disparities increase whenever the algorithm is sufficiently uninformative and the fixed cost of acquiring information is positive, and decrease whenever the fixed cost is zero for any algorithm. We provide a statistical test on whether the fixed cost is positive. We argue that *bunching the recommendations* is an effective way to decrease the group disparity. Traditional prescriptions such as making the algorithms unbiased, making the algorithm transparent and training judges to better understand the algorithm do not necessarily reduce the group disparities.