Sumit Goel

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Education

California Institute of Technology — Pasadena, CA
PhD in Economics (with minor in Computer Science) — 2017 – 2023 (exp.)
Advisor: Federico Echenique

Indian Statistical Institute — Delhi
MS in Quantitative Economics — 2015 – 2017
Advisor: Arunava Sen

Delhi Technological University — Delhi
BTech in Computer Science — 2011 – 2015

Research interests

Game theory, Mechanism design, CS-Econ

Research

1. Prizes and effort in contests with private information
Job market paper

Abstract: We consider contests where agents have private information about their ability and study the effect of different prizes and competition on the effort exerted by the agents. We characterize the symmetric Bayes-Nash equilibrium strategy function and find that the effect of prizes and competition depend qualitatively on the distribution of abilities among the agents. In particular, if there is an increasing density of inefficient agents, increasing the value of prizes or making the contest more competitive encourages effort. In contrast, if the density is decreasing, these interventions discourage effort. We discuss applications of these results to the design of optimal contests in environments that impose natural constraints on feasible contests including grading contests, contests where agents have concave utilities for prizes, and contests where the designer can only award homogeneous prizes of a fixed value.

2. Stable allocations in discrete economies (with Federico Echenique and SangMok Lee)

Abstract: We study discrete allocation problems, as in the textbook notion of an exchange economy, but with indivisible goods. The problem is well-known to be challenging. The model is rich enough to encode some of the most pathological bargaining models in game theory, like the roommate problem. Our contribution is to show the existence of stable allocations (outcomes in the weak core, or in the bargaining set) under different sets of assumptions. Specifically, we consider dichotomous preferences, categorical economies, a gains from trade property, and discrete TU markets. The techniques used are varied, from Scarf's balancedness condition, to a generalization of the TTC algorithm by means of Tarski fixed points.

3. Project selection with partially verifiable information (with Wade Hann-Caruthers)
Extended Abstract in *Proceedings of WINE 2022*
Abstract: We consider a principal agent project selection problem with asymmetric information. There are N projects and the principal must select exactly one of them. Each project provides some profit to the principal and some payoff to the agent and these profits and payoffs are the agent's private information. We consider the principal's problem of finding an optimal mechanism for two different objectives: maximizing expected profit and maximizing the probability of choosing the most profitable project. Importantly, we assume partial verifiability so that the agent cannot report a project to be more profitable to the principal than it actually is. Under this no-overselling constraint, we characterize the set of implementable mechanisms. Using this characterization, we find that in the case of two projects, the optimal mechanism under both objectives takes the form of a simple cutoff mechanism. The simple structure of the optimal mechanism also allows us to find evidence in support of the well-known ally-principle which says that principal delegates more authority to an agent who shares their preferences. For $N > 2$ projects, we provide an upper bound on the principal's payoff under any mechanism and show that the payoff from the optimal cutoff mechanism nearly matches this bound; consequently, we conjecture that the optimal mechanism is a cutoff mechanism for any number of projects.

4. Optimality of the coordinate-wise median mechanism for strategyproof facility location in two dimensions (with Wade Hann-Caruthers)
Published in *Social Choice and Welfare*, Extended Abstract in *Proceedings of SAGT 2022*
Abstract: We consider the facility location problem in two dimensions. In particular, we consider a setting where agents have Euclidean preferences, defined by their ideal points, for a facility to be located in $\mathbb{R}^2$. We show that for the $p-norm$ ($p \geq 1$) objective, the coordinate-wise median mechanism (CM) has the lowest worst-case approximation ratio in the class of deterministic, anonymous, and strategyproof mechanisms. For the minisum objective and an odd number of agents n, we show that CM has a worst-case approximation ratio (AR) of $\sqrt{2}\frac{\sqrt{n^2+1}}{n+1}$. For the $p-norm$ social cost objective ($p \geq 2$), we find that the AR for CM is bounded above by $2^{\frac{3}{2}-\frac{2}{p}}$. We conjecture that the AR of CM actually equals the lower bound $2^{1-\frac{1}{p}}$ (as is the case for $p = 2$ and $p = \infty$) for any $p \geq 2$.

Honors and scholarships

Graduate Fellowship in Data Science (PIMCO)	2020
Repetto-Figueroa Family Graduate Fellowship (Caltech)	2020
Linde Institute Summer Fellow (Caltech)	2020
Graduate Student Fellowship (Caltech)	2017
Rank 1 in MSQE Program (ISI Delhi)	2017
Masters Student Fellowship (ISI Delhi)	2015 – 2017

Conferences

Winter school at Delhi School of Economics (2019); 8th Annual conference on Contests: Theory and Evidence (2022); 16th Meeting of Society for Social Choice and Welfare (2022); SAET (2022); Asian School in Economic Theory (2022); SAGT (2022)

Referee — Theoretical Economics

Teaching exp.

Teaching assistant, Caltech

Designed and graded problem sets, conducted office hours

Ec 122: Econometrics	Fall 2018, Fall 2019
Ec 11: Introduction to Economics [edX]	Winter 2018
BEM 103: Introduction to Finance	Winter 2019, Winter 2021
PS/Ec 172: Game theory [webpage]	Spring 2020
Ec 121A: Theory of Value	Fall 2021
CS/Ec 149: Algorithmic Economics [notes]	Spring 2022

Instructor, Econschool

Taught Mathematics to undergrad students in India interested in pursuing higher studies in Economics. Also developed a website visited by over 150 students daily [econschool.in].

Other exp.

Caltech COVID-19 Research Project — Summer 2020

Under supervision of Prof. Yaser Abu-Mostafa, contributed to development of a machine learning-based model to predict the spread of COVID-19 in the US. The predictions are part of The US COVID-19 Forecast Hub dataset published in Scientific Data, Nature.

Research assistant for Prof. Federico Echenique — Spring 2019

Surveyed experimental papers that use the convex time budget methodology for estimating time and risk preferences

Intern at Royal Bank of Scotland — Summer 2014

Wrote XSLT code to enhance Excel reports by introducing charts alongside data tables while ensuring easy integration with existing report generation process

Service

Treasurer of Caltech Badminton Club	2018 – 2022
Graduate representative of Caltech HSS DEI committee	2020 – 2022
President of Caltech Cricket Club	2018 – 2020

Miscellaneous

Programming: R, Latex, C, C++
Languages: English (fluent), Hindi (native)
Personal: Indian citizen, born November 30, 1992

References

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