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## 2 From U.S. Win Nobel in Economics

By CATHERINE RAMPELL

Two Americans, Alvin E. Roth and Lloyd S. Shapley, were [awarded the Nobel Memorial Prize in Economic Science](#) on Monday for their work on market design and matching theory, which relate to how people and companies find and select one another in everything from marriage to school choice to jobs to organ donations.

Their work primarily applies to markets that do not have prices, or at least have strict constraints on prices. The laureates' breakthroughs involve figuring out how to properly assign people and things to stable matches when prices are not available to help buyers and sellers pair up.

Mr. Roth, 60, has put these theories to practical use, in his work on a program that matches new doctors to hospitals and more recently for a project matching kidney donors. Public school systems in New York, Boston, Chicago and Denver use an algorithm based on his work to help assign students to schools. A professor at Harvard, he recently accepted a [new position](#) at Stanford.

"Al has spent the last 30 years trying to make economics more like an engineering discipline," said Parag Pathak, an economics professor at M.I.T. who has worked on school-matching systems with Mr. Roth. "The idea is to try to diagnose why resource allocation systems are not working, and how they can be engineered to produce something better."

Mr. Shapley, 89, a mathematician long associated with game theory, is a [professor emeritus at the University of California, Los Angeles](#). He made some of the earliest theoretical contributions to research on market design and matching, in the 1950s and 1960s.

In a paper with David Gale in 1962, Mr. Shapley explained how individuals could be paired together in a stable match even when they disagreed about what qualities made the right match. The paper focused on designing an ideal, perfectly stable marriage market: having mates find one another in a fair way, so that no one who is already married would want (and be able) to break off and pair up with someone else who is already married.

In the 1980s, Mr. Roth applied this work to matches for medical residency programs and eventually school choice. He was interested in how to keep matches fair and how to keep more sophisticated players from manipulating the system to their advantage.

In older matching systems, a student would apply to his first-choice school, which was often popular. If the student did not get in, then the application would be sent on to the student's second choice. But if that was also a popular choice, then that school's program would have already filled up by the time his application was even considered, and the process would repeat itself with his third-choice school and so on.

Even if students were qualified to get into one of their top schools, they could be shut out because they did not rank their preferences strategically. This created an incentive to try to game the system by listing a less popular school as their first choice because that way they would at least have a chance of getting in somewhere.

Mr. Roth designed a system in which students had an incentive to tell the truth about where they wanted to go. A centralized office could then assign them to a school best suited for them, based both on their own preferences and the preferences of the schools they were applying to.

The school systems he helped create use a "deferred acceptance algorithm," which was developed by Mr. Shapley's theoretical work.

The system works by tentatively accepting students to their top-choice school. It holds off on the final assignment until it has gone through all the other applications to make sure there are not other students who have a higher claim to a spot at that given school (because of higher test scores, a sibling at the school or whatever other criteria the school prioritizes), even if those students happened to rank the school lower on their list of preferences.

"The idea is to level the playing field," Mr. Pathak said. "You want to make sure that not only do sophisticated players not have to spend the time learning the strategies and different heuristics that will get them ahead, but also that unsophisticated players are not hurt by the fact that they are not aware of all this information."

This same sort of system is used to match new medical school graduates to medical residency programs, which was once a messy process that led to a lot of unhappy candidates. Now all residency assignments are posted simultaneously. In the mid-1990s Mr. Roth redesigned the system to help match married couples who were [jointly looking](#) for jobs at hospitals.

Mr. Roth has also helped build a system that assigns kidney donation swaps.

For example, a man needs a kidney, and his wife is willing to donate one of hers but she is not a match. Across the country there is a couple in the same position, and it turns out that the wives are a match for the husbands in the opposite couple. In this simple case, the two couples essentially barter their kidneys: Wife A gives her kidney to Husband B, and Wife B gives her kidney to Husband A. It is rare that two couples will serendipitously match each

other's kidney donation needs this way, and there are often more pairs of donor-recipients involved. Mr. Roth's system helps find the most efficient exchange of organs so that the most patients can be saved with the fewest number of pairs involved in a given trade.

Mr. Shapley was born in Cambridge, Mass. He received his bachelor's degree from Harvard and his a Ph.D. in mathematics at Princeton, where he studied alongside John Nash, a fellow Nobel laureate. He is married and has two sons.

Mr. Roth received his bachelor's from Columbia and his master's and doctorate from Stanford, all in operations research. He is married with two children.

The Nobel in economic science is not one of the original prizes created by Alfred Nobel. It has been awarded each year since 1969 by the Royal Swedish Academy of Sciences. In addition to a medal and a diploma, the laureates collectively win a cash prize worth about \$1.2 million.

*This article has been revised to reflect the following correction:*

***Correction: October 15, 2012***

An earlier version of this article included an incomplete credit for the picture of Alvin E. Roth. The full credit is Linda A. Cicero/Stanford News Service, via Associated Press — not the Associated Press.