

 <p>Mathematics Department</p>	<p>Profile of the Month Prof. John Turner</p>
<p>Chauvenet Hall Editor: Prof. S. Garcia</p> <p>Phone: 410-2936728 www.usna.edu/MathDept/</p>	<p>Prof John C Turner received his PhD in Statistics from Princeton University in 1976. Prior to that, he received his BA in Mathematics from Rice University. He has been at USNA since</p>
<p>1978. As a statistician, Prof Turner has worked on a wide variety of problems. For 24 years, he worked with scientists at the David Taylor Research Center (now part of Naval Surface Weapons Center). Among the projects on which he has worked was one on comparing anti-fouling paints as well as a project that involved using onboard measurements to predict the failure of shipboard equipment, such as ship's service diesel generators. The most significant work at NSWC was for the electromagnetic silencing group. This work posed a number of interesting problems and involved travel to various sites, such as the Bahamas and Scotland. Unfortunately, these trips generally involved a fair bit of time onboard submarines and not sight seeing.</p> <p>In the early 1990s, Prof Turner, along with Prof Fowler, began to explore the impact of the then-new graphing calculators on the teaching of probability and statistics. Ultimately, they wrote a text for SM230, which Prof Turner revised several times.</p> <p>Prof Turner's primary interest these days is the teaching of elementary probability and statistics. He has presented papers at professional meetings on such issues as the effect of violating the assumptions of various distributions and the importance of modeling in teaching probs&stats. He is also the author of a supplement that was written to accompany a major statistics text. The supplement uses actual journal articles to illustrate the ideas of statistical inference and is</p>	<p>based on ideas Prof Turner developed for SM439. The first edition of the supplement has sold over 4700 copies and a new edition with more articles is currently in the works.</p> <p>When he is not doing probability and statistics, Prof Turner enjoys music. He sings in the Queen Anne's Chorale and is choir director at his church. He, his wife Carol and their cat Polly live in Centreville, on Maryland's Eastern Shore.</p>
	

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CAN I BE A MATH MAJOR AND STILL BECOME AN ASTRONAUT? (Part II)

Eileen Collins, commander of the shuttle Discovery that recently returned the United States to manned space flight 2 and 1/2 –years after the loss of the shuttle Columbia, has the “right stuff” as far as the Operations Research profession is concerned. Collins earned a master’s degree in operations research from Stanford University in 1986. Of course, a master’s degree in O.R. alone didn’t put Collins in command of the space shuttle mission, but it certainly played a key role in her remarkable career.

At 16, Collins began working and saving her earnings to pay for flying lessons. At 19, she used a thousand dollars in savings to get lessons at her local airport. In 1978, she earned a bachelor’s degree in **math** and economics from Syracuse University. That same year, she began Air Force pilot training, the same year NASA opened the shuttle program for women. In 1979, Collins graduated from Air Force Undergraduate Pilot Training at Vance AFB, Oklahoma, where she was a T-38 instructor pilot until 1982. From 1983 to 1985, she was a C-141 aircraft commander and instructor pilot at Travis AFB in California. In 1989, three years after earning her master’s in O. R., Collins earned a master’s degree in space systems man-

agement from Webster University. In 1990, NASA selected Collins to join America’s Astronaut Corps. Collins has logged more than 6,280 hours in 30 different types of aircraft. Before the recent Discovery flight, Collins had more than 537 hours logged in space. She was the first woman pilot of a space shuttle on the first flight of the joint Russian-American shuttle- MIR program. She was the first woman to command a shuttle mission.



National Aeronautics and Space Administration
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OR/MS Today magazine

Math meets medicine: graph theory in kidney transplantation

By Prof. Gentry Dr. Dorry Segev, a transplant surgeon at the world-renowned Johns Hopkins Hospital, still marvels at how sick patients can lead full lives after they receive a kidney transplant. The essential ingredient in such a recovery is a human kidney, and those are in short supply. Over 60,000 patients in the U.S. are waiting for a kidney from a deceased donor. Members of a kidney patient's family are often willing to be live kidney donors, but many such offers must be rejected because of blood-type or tissue-matching incompatibility. In a paired kidney donation, two families in this situation receive their transplants. The donor of the first family gives to the patient of the second, and vice versa. Surgeons and patients hope that a na-

tional registry of incompatible donor-patient pairs may soon be available. USNA math professor Sommer Gentry works with Dr. Segev, also her husband, on mathematical problems in organ allocation. A graph theory tool called the Edmonds algorithm could enable surgeons to complete almost two thousand more kidney transplants this year. Each patient with his donor forms a dot, or a node, in a network. A link connects any two nodes representing a foursome that are compatible for a paired donation. This network of nodes and the links connecting them is called a graph. A national registry would examine the donors and patients and draw links to show all the compatible paired donations possible. After finding the links, how can surgeons decide which matches among

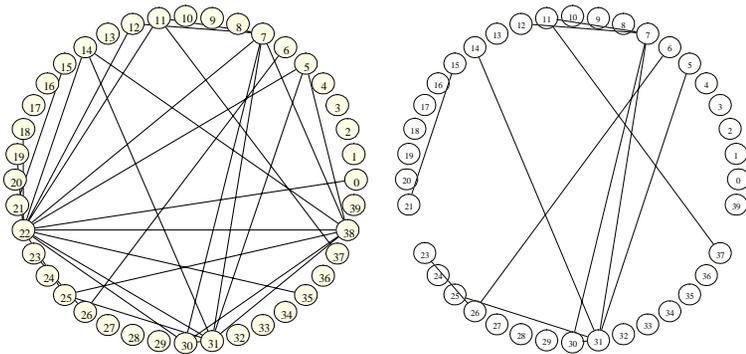


Figure 2. Graph of Donor/Patient Nodes, With Links for Compatible Matches.

(a) Each node represents a recipient and his or her live incompatible donor. The most links (13) are seen by pair 22, a blood type A recipient with a blood type O donor. Pair 5 sees 3 links with a type O recipient and a type A donor.

(b) By matching the strategically wrong pairs, without first considering all possible combinations of matches, many future possibilities are lost. To demonstrate this, the same nodes and links from (a) are shown after matching pair 22 with pair 38.

all those links would give the greatest number of transplanted kidneys? One simple method would be to choose any two linked families to exchange first, and choose any other two linked families to exchange next, et cetera, until no more paired donations are possible. This approach would ignore the other connections in the graph, but it is the connection structure of the graph that determines the number of transplants. Some patients and their donors will be linked to a large number of potential matches, but other patients will be linked to only a handful of other pairs in the entire nation. With very few links, a patient is unlikely to receive a paired donation if the system fails to take the number of links per patient into account. The decision to match pair A with pair B for donations affects every other patient in the graph. Deciding which pairs should be matched, while considering all of the connections in the graph, requires the Edmonds algorithm. To a mathematician, the optimized system is guaranteed to perform the best. However, the gold standard in medical

research is the clinical trial: a study involving a large number of patients assigned to receive different treatments. Gentry and Segev propose that some medical research should be conducted by *computational trial*: an experiment that uses computers, along with known characteristics of patients, to predict the results of medical decisions. Gentry and Segev's computational trial simulated all U.S. patients requiring kidneys. Nearly 1900 additional kidney transplants would result from a national optimized match, compared with slightly more than 1600 transplants in a non-optimized national match. Before the computational trial, transplant physicians knew that the paired donation approach had promise. After the computational trial they knew exactly how many patients with willing donors could already have received a kidney with paired donation. When experts in math and medicine think collaboratively about organ allocation, patients are the winners.

Answer for last issue question: Ans. 27 since $2+7=27^{(2/3)}$ MIDN 2/C Monika L Hess and MIDN 4/C Nathan Greenwood are last month's winners.

Question of the Month

Find a palindrome that is a cubic number less than 2000. E-mail your answer to Prof. Garcia smg@usna.edu. Among those with the right answer, a randomly chosen midshipman will get to choose between a fantastic math water bottle or a cool koozie.

The symbol used on the head of Math News is one of the Platonic Solids. Ref. <http://mathworld.wolfram.com/PlatonicSolid.html>.