DNDO intern applied statistical knowledge to strengthen national security efforts

By Jordan Stidham

James Duncan spent a summer internship researching radiation portal monitors and high dimensional data. During his time in the U.S. Department of Homeland Security Domestic Nuclear Detection Office Summer Internship Program, Duncan used his background in statistics to help determine data patterns in an effort to detect and deter the smuggling of radiological/nuclear materials.

In high school, James Duncan was strongly fascinated by both the sciences and humanities. For his undergraduate degree, Duncan pursued a major in history at the University of Wisconsin-Madison. Not long after graduation, Duncan realized his strong desire to return to a science, technology, engineering and mathematics (STEM) related-field.

Duncan began studying math and computer science in his spare time while working as a web developer. He stayed in that position for five years and also kept studying math and computer science with the intent of pursing a master's degree. He enrolled at the University of Illinois at Chicago (UIC) for three semesters to take the prerequisite classes. It was at UIC where Duncan had his first rigorous introduction to statistics, and he fell in love. Subsequently, Duncan enrolled in the master's program at the University of California, Berkeley, to study statistics.

Duncan was researching internships at national laboratories in Zintellect, an application system for internships and experimental research opportunities administered by the Oak Ridge Institute for Science and Education (ORISE), when he came across the U.S. Department of Homeland Security (DHS) Domestic Nuclear Detection Office (DNDO) Summer Internship Program.

"I saw a tremendous opportunity for personal growth and to work toward making our country and the world a safer place in which to live," Duncan said.

The DNDO Summer Internship Program provides opportunities for undergraduate and graduate students to participate in projects at federal research facilities across the United States. Participants address issues related to national security and nuclear detection to help DNDO meet its mission of preventing nuclear terrorism and training future generations of scientists.

Duncan became interested in the project of scientist Lori Dauelsberg, Ph.D., of Los Alamos National Laboratory (LANL), who is a mentor for the program. Duncan immediately knew he had found the perfect match. "I was very excited to be faced with this open-ended challenge to find patterns in such a unique data set, one that would put my skills in parallel computation, data cleaning, data visualization and analysis and statistical modeling to the test," he said.

At LANL in New Mexico, Duncan was assigned to the A Division, the Analytics, Intelligence and Technology team. Duncan participated in projects directed to research radiation portal monitors (RPMs). RPMs are gamma and neutron radiation detectors designed to scan cargo, vehicles and passengers at seaports, border crossings and airports.

The goal of this research is to uncover a pathway to unlock the data in such a way that it becomes more useful to the data analyst charged with interpreting it and detecting radiological/nuclear (R/N) threats.

Duncan used the techniques of exploratory data analysis and interactive data visualization aided by dimensionality reduction methods and the R package Shiny. Shiny is an application that enables users to turn their analyses into dynamic and interactive web applications in which users can select their own parameter settings, filter the data and carry out exploration from many different angles.

"My goal was to build a prototype of an interactive data analysis tool for the RPM data that would show off its dynamic nature, making it easy for national security analysts to dive in and start interacting in an intuitive way with the data to answer their questions," he said.

His research benefits the average American by protecting the United States from the great harm that can result from the illicit smuggling of R/N material. While the smuggling of R/N material is quite a rare event, it is one that is incredibly hazardous to our national security.

This experience helped Duncan develop the skill set needed to become a successful data scientist as well as traits important to thrive in a professional work environment. "I learned important lessons about data visualization and presentation, and I improved my ability to communicate findings in a straightforward and meaningful manner. I got to see the scientific method put into action by practitioners, such as my mentor, Dr. Lori Dauelsberg, who have huge amounts of competence and skill," Duncan recalled.

Duncan plans to continue his studies and earn a doctorate in statistics, and he hopes to return to a national laboratory in the future. He commented, "[National laboratories] are very special institutions that play a crucial role in keeping the U.S. at the forefront of science and keeping U.S. citizens safe from harm, whether that be from R/N threats, disease, environmental dangers, or in any form."