STATISTICAL SCIENCE IMPROVING AGRICULTURE

STATISTICAL SIGNIFICANCE

Agriculture is central to our economy, our health, our environment, and our security. Farmers, producers, and distributers are under constant pressure to improve yield, provide safe food, ensure nutrition, contain costs, etc. Statistical science and statisticians are vital to addressing each of these challenges.

Agriculture and Food

ANIMAL AND PLANT BREEDING

As the world's population has increased dramatically in recent times and continues to rise, a corresponding increase in the food supply is needed. Plant and animal breeders have worked closely with statisticians on breeding programs that have produced huge increases in crop yields and meat and dairy products. For example, average corn yields in the United States have increased over the past century from 25 bushels per acre to more than 150. The analysis of data from breeding programs has motivated the development of key statistical methods and computing strategies, and, along with the recent explosion of genetic information, will help drive further increases in sustainable food production, even as environments change.

AGRICULTURAL RESEARCH AND STATISTICS INTERTWINED OVER LAST CENTURY

Fundamental to improving crop yield is the necessity to quantify effects of such factors as crop varieties, nutrients, and fertilizers on crop yields. Statisticians have been integral to this effort for a century. Ronald Fisher, one of statistics' most important historical figures, developed his principles of experimental design in the context of agricultural field trials in the 1910s and 20s. Fisher invented statistical models to account for confounding factors affecting crop yields such as soil type or weather. These principles, along with new statistical methods, continue to have an important role in agricultural research. For example, developments in spatial statistical models have contributed to precision agriculture, a farm management strategy that uses global positioning systems to target interventions to the needs of a crop at a specific location in a field.

EFFICIENT AND FAIR COMMODITY MARKETS

Statistical survey data on acreage and crop production provided by the National Agricultural Statistics Service (NASS) are essential to the workings of the agricultural free market. Farmers use the data, along with commodity prices, to make business decisions such as which crops to plant, how many cattle to raise, and when to harvest and sell products. The data, updated throughout the growing season, help to determine commodity prices. Companies involved in transportation, storage, and farm supplies use the data to develop business plans. The key to an efficient commodity market is high-quality information on supply and demand, available to all players, throughout the production cycle.

INFORMING FARM AND FOOD POLICY

Statistical data and analyses inform decisions about farm, food, rural development, and natural conservation policies. For example, the USDA's Economic Research Service (ERS) monitors the extent and severity of food insecurity in America through an annual, nationally representative survey of households to derive the consequences of food assistance programs and guide federal programs like the Supplemental Nutrition Assistance Program (formerly known as food stamps). ERS also draws on comprehensive farm-level data to detail changes in farm size and other attributes of farm structure; identify key driving forces behind consolidation and concentration in the agricultural sector; and evaluate implications for farmers, natural resource use, agri-business, and consumers.

ENSURING FOOD SECURITY AND SAFETY

Protecting local and global food supplies is made challenging by many factors, including the diversity of food sources/producers, a complex production and distribution network, and the large volumes/quantities of food. Sophisticated statistical sampling techniques and quality control methods are at the heart of monitoring and ensuring food safety. For example, statisticians have helped packing houses find ways to economically reduce the number of bacteria in and around packing houses. Protecting ready-to-eat products such as lunch meats and hot dogs from contamination by *E. coli*, salmonella, or other pathogens while minimizing the use of chemicals is another persistent challenge. Here, statisticians have worked with food scientists on the use of naturally occurring antimicrobials to reduce dependence on their commonly used chemical counterparts.

"Statistical Science Improving Agriculture" is part of Statistical Significance, a series from the American Statistical Association documenting the contributions of statistics to our country and society. For more in this series, visit *www.amstat.org/outreach/statsig.cfm*. The American Statistical Association is the foremost professional society of statisticians, representing 19,000 scientists in industry, government, and academia: *www.amstat.org*. This Statistical Significance was produced under the supervision of the ASA Scientific and Public Affairs Advisory Committee.

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