Birds, baseball and Reverend Bayes:

How to train an auditor

by Shyam Sunder

Auditors do not begin checking an organization's accounts and reports with a blank slate.

Auditors usually know a lot about an organization's history, people and current conditions. When they find something unusual or wrong during their check of accounts, they combine this information with their prior knowledge to decide what to do. The statistical procedure for combining prior knowledge with new data is called "Bayes' Rule" after the Rev. Thomas Bayes who proved the theorem in the 18th century.

For example, an auditor may know from previous experience that on average, 10 percent of the inventory accounts have errors, and that for 95 percent of the organizations the error rate falls between 14 and six percent. Upon checking 100 randomly selected inventory accounts of an organization, the auditor finds errors in five. Bayes' Rule allows the auditor to place partial reliance on his previous experience (10 percent error rate) and partial reliance on the evidence gathered (five percent error rate) to yield an estimated 8.5 percent as the most likely rate of error in the organization's inventory accounts. Furthermore, the auditor can have 95 percent confidence that the error rate in these accounts falls between 5.5 and 11.5 percent. Having optimally combined information from both sources, the auditor is better equiped to chart the further course of audit.

How good are we at intuitively using the Bayes' Rule in our day-to-day affairs? Formal use of Bayes' Rule often requires complicated arithmetic calculation. Even those who have the necessary arithmetic skills may not know the Rule. Perhaps we should not expect most of us to be very good at intuitively using Bayes' Rule. But then, few baseball or pool players have intimate knowledge of Newton's Laws of Motion. Through repetition and practice, they make up for their inability to solve the relevant differential equations. In fact, they do so well that few physicists can match their skills.

Whether people can learn to use Bayes' Rule intuitively and without formal arithmetic calculation is an important question for training and educating auditors and many other professionals. If they have the ability to learn, what conditions facilitate such learning? Currently, we have no theory to help answer these questions. We, and others before us, have therefore resorted to empirical investigation—try and see what happens.

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Experiments conducted with people isolated from each other show that most people are not very good at using Bayes' Rule intuitively. They tend to place too much weight on what they immediately observe and too little on what they know from previous experience. Researchers have compiled convincing evidence that human beings are not genetically preprogrammed to be Bayesians the way birds and insects are genetically preprogrammed to fly.

But all hope is not yet lost. Man does learn to play ball, and can do so without conscious effort once learning has been accomplished. Couldn't the same hold true of Bayes' Rule? Learning is helped by reward and reinforcements. Perhaps there exist learning conditions where rewards and reinforcements are just enough that people can learn to become Bayesians intuitively.

A competitive market is one such possible environment. It financially rewards those who use Bayes' Rule. It also allows them to learn from their mistakes and correct themselves by observing the behavior of others. So Rong Ruey Duh, Ph.D. student in accounting, and I decided to find out if people can learn to be intuitively Bayesian when trading in a competitive market with real money.

The answer we have found so far is a weak yes. We have observed that the behavior of people is closer to Bayesian than other behavior models. However, it is not precisely Bayesian. Perhaps, conditions do exist where we can train peo-

ple to act as Bayesians without having to equip them with calculators, formulas and computers.

Questions of how people process information and how one might train auditors to conduct their work are of more than academic significance. The Auditing Standards Board, the auditing rule-making body of the American Institute of CPAs, recently split into two factions, popularly labelled "quantos" and "judgos." The "judgos" camp believes in man's innate ability to make judgments based on available data without using formal statistical sampling and inferential procedures. The "quantos" apparently do not have such faith in the

human computer and have pushed for a statistical formalization of the standard procedures of the audit profession.

The debate in the audit profession is not unique. The problem is more general and extends to many, if not all, professions. Many of the related issues are currently being investigated under the banner of artificial intelligence.

We presented our results at a University of Oklahoma conference last November. It was specially arranged to discuss this and other accounting research which use experimental economics methods. Many leading accountants and economists attended the conference. A volume of papers presented at the conference will be published in 1986.

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