

Information, Plans, and Choice

Lecture 1: Introduction

(U. Bayreuth, Spring 2006)

I. Course Details and the syllabi can be found on the class website, which can be found on the right hand side of my website, RDC1.net, under Class Materials, Bayreuth.

II. Informational Sets and the Sensory Order

- A. There is a sense in which all of our experience consists of information.
- ♦ What we process in our minds are various bits of sensory perception, data that we use to make sense of the world.
 - ♦ For the most part, our sense of the world is the result of conscious and subconscious efforts to interpret that sensory data.
 - ♦ The result might be called the "sensory order" using one of Hayek's terms, or it might be termed our "information set" to use terminology from modern game theory.
- B. Our sensory order consists of patterns that we perceive, theories that connect actions with consequences, that organize the world that we perceive it.
- C. Our efforts to make sense of the world are clearly helped enormously by various techniques of communication between people.
- ♦ Mothers, Fathers, Family, and Friends are able to persuade us that certain ideas are useful, that certain patterns exist, and that certain strategies for life tend to be successful.
 - ♦ This ability to "finish the processing" of "refined data" allows us all to make a great deal more sense of the world that would be possible on our own.
- D. To the extent that these ideas or theories about the world prove useful in our own experience and strategies for living generate reasonable success, when we pass on our "thoughts" on these matters to our friends, families and children, we are helping to create a pool of useful and tested information for our "clan" and also to the extent that we are linked through communication networks for society at large.
- ♦ In modern computing terms, we are a type of "neural network" of theory testers and pattern recognizers.

- E. None the less, the information (refined data) that we all receive for free from our friends and families, and from helpful teachers and strangers, remains incomplete in many ways.
- ♦ Not all of the "thoughts" that we accept or refine will be entirely correct in the sense that they are the most useful way of organizing the sensory data or most effective strategies for our lives.
 - ♦ This is partly because everyone's circumstances are a bit different, and to the extent that "received wisdom" is a not entirely general or generalizable, we will confront situations in which more or different information would be helpful.
 - ♦ And, it is partly because the pool of "received wisdom" is itself a work in progress, which does not include everything that might be useful to know, but rather that which is believed to be useful for "typical" people operating in "typical" circumstances in which it has proved useful or effective.
 - ♦ It is also partly because the "partially refined data" that are passed on to us are missing dimensions that would prove useful.
- F. Thus, received wisdom changes through time as circumstances change and as better theories and data are tested and found useful or effective--or perhaps just interesting.
- G. And, moreover, our own theories and desire for additional information--better theories and strategies for life--after all as economists often correctly insist "more is better" or in this case perhaps "better is better," there is always room for improvement.

III. Choices between "Informational Alternatives"

- A. That one's information set (sensory order or ideology) is important should be obvious when one realizes that the opportunities that one chooses among are all informational in nature at the moment of choice.
- ♦ Clearly the physical counterparts to the ideas and images that we carry in our minds could not themselves fit inside a human skull.
 - ♦ In this respect, decision making is all about information. It uses information to select among plans of action whose consequences are entirely informational at the moment they are chosen.
 - ♦ Once a course of action is adopted, it may prove to have the anticipated consequences or not, or additional information may become available that allows us to better understand the opportunities that we confront.

- ◆ Either may cause us to change our plans, to admit mistakes (if our assessment of previously held information was faulty--I "thought the light was green" Mr. Policeman) or simply to improve our plans in light of better information.

B. Fundamentally, all decision making is fundamentally information--but this is most obviously true of what might be regarded as "rational" decision making, in which we actively assess theories and alternatives before choosing actions.

IV. From Sensory Order to Common Sense and Analytical Representations of Information

A. Fortunately, there is significant agreement among our perceived "sensory orders" which both allows to communicate and is partly a consequence of that communication.

- ◆ In this sense, we are able to agree that much exists in the real world--our common perceptions
- ◆ And, yet there remains much that cannot be agreed upon, or easily communicated. There is a residual in which we live in our private worlds.

B. The former, however, allows us to use common sense expressions for the real world, as well as to develop fairly general analytical representations of both sorts of information. (We can also agree that our models are reasonable.)

- ◆ Note that these model extent to private information, to a limited extent, insofar as we all acknowledge "knowing" some things personally that others do not.
- ◆ (Some of this is simply what might be called idiosyncratic experience: we know the colors of our friends and families eyes, the names of some streets and villages, words in a foreign language, etc. because we have done things seen things that many others have not. Other's are evidence of our own creativity or independent information processing activities.)

V. Within economic and game theory, there are fairly conventional (widely accepted) ideas about how to represent the information sets of individuals.

A. This partly reflects the shared experience and education of economists, of course, but it hopefully also reflects fairly general and useful properties of information itself.

- ◆ By this I do not mean the common theories and empirical evidence that most of us in Economics learn as part of our training and extend as part of our own active (and hopefully) creative research.

B. What I mean is that there are "normal" assumptions made about the kind and quality of information available to individuals at the moment of choice.

- ◆ Much is assumed to be known by individual, perhaps because of "received wisdom" or perhaps of imagined but unmodeled personal experience.

C. For example it is common to assume that consumers know their own preferences (utility function) and also know a good deal about their opportunity set over income generating activities as well as goods and services.

- ◆ In many cases, most information problems are ignored in order to focus attention on some other issue of interest (the effect of price on quantity demanded or profits), which may not be affected by small changes or variations in information among the individuals in a given market.
- ◆ Some times these information assumptions are done after reflection (on purpose), but in many others they are made without thought--nearly by accident.
- ◆ It is for correcting "mistakes" associated of this last sort of reasoning that several people have won Nobel prizes in the past two decades.
- ◆ (A partial list might include: Hayek, Stigler, Spence, Stiglitz, Akerlof, and Schelling, many of whom are on the reading list.)

D. And it bears noting, that it is still commonplace for economists and game theorists to assume that rational individuals know all they need to make essentially perfect decisions.

- ◆ (Lucas won a Nobel prize for showing how such assumptions can be done in an environment where not all could be known with certainty. His prize came from applying the "rational expectations" representation of information to macro-economic models)

VI. One important economic concept about information is that it is often costly to acquire or costly to process.

A. And for this reason, it is *often completely rational to remain imperfectly informed.*

- ◆ *Some information costs more than it is expected to produce in expected benefits.*

B. Originally, this idea was called **rational ignorance**.

- ◆ A rational person operating in a setting of scarce time and attention will devote only so much time (and money) to gathering information (refined data) and making sense of it.
- ◆ I will argue in this lecture (and have in the assigned reading) the original literature on this subject confused two quite different decisions about information--one one of which can properly be called "ignorance."

- ♦ I will also argue that it is useful to distinguish between "rational" and "natural ignorance."
- C. There are two quite useful representations of information that are widely used by economists, political scientists, statisticians, and many others:
- ♦ The first is "binary:" you either know something or you do not.
 - ♦ The second is "continuous" or statistical, you may know or understand some relationship or feature of the world with more or less precision. The more you know about something (the larger your data set) the more precise are your estimates of that relationship or feature of the world.
 - ♦ The latter allows the process of learning to be represented mathematically as a more or less contiguous function--often based on Bayes' Law.
- D. Economists typically use statistical representations of imperfect information in their models and game theorists typically use binary representations of imperfect information in theirs--to the extent that either focuses on the effects of imperfect information on choices made in the setting of interest.
- ♦ However, both kinds of information problems exist, and both kinds can usefully be incorporated into rational choice models.

VII. In Defense of Ignorance (excerpt from assigned reading)

Two Kinds of Imperfect Information

- When individuals search for data in the widely used sense pioneered by Stigler (1961), it is generally assumed that the relevant probability distribution is already known by the persons doing the searching or at least can be readily determined from a small enough number of observations that such knowledge is economically feasible. Increases in sample size (or experience) take place without changing the number of characteristics that are tabulated and without significantly changing the domain of sampling. Becoming better informed in this context has a clear meaning derived from sampling theory. The more one knows (the larger the sample), the more accurate one's estimates of the underlying real phenomena tend to become. In this finite sample sense, imperfect information may be said to exist if further sampling can increase the precision of one's perceptions of the world.
- Knowledge based on a restricted subset of the potentially available data implies a substantially different form of incomplete information. The domain of possible events is only partially known by persons who are constrained by ignorance. The usual probabilistic characterization of generalized search models implicitly rules this possibility out. Knowledge of a probability distribution implies that searchers are aware of *every* possible event (price, product, temporal sequence, invention, context) that *can potentially occur* or be found. Ignorance implies that individuals cannot fully know the domain of the distribution that is relevant for the choice at hand or the

dimensionality of possibilities they partially recognize. In other words, the existence of ignorance generally implies a *complete lack of knowledge* about a variety of real or imagined possibilities.

- To eliminate or reduce this form of incomplete information requires changing the range of possibilities considered or the number of characteristics observed. Interpreted in sampling terms, reductions in ignorance can be accomplished by tabulating *new features* of the sample at hand or by reducing constraints that previously limited the sampling of features already tabulated. Note that both these data set problems imply that *ignorance does not necessarily diminish as sample size, per se, increases*.
- The distinction between these two types of incomplete information would be of little interest for economists or social scientists if their implications for rational decision making were identical or if the same activities always induced similar changes in both types of incomplete knowledge. But neither of these conclusions holds universally. In many cases, ignorance has implications that significantly differ from those associated with the finite sample representations of incomplete information.
- To see this, consider a simple price search model. Suppose that someone is attempting to purchase some widely sold commodity, say, a coffee maker. Suppose also that there are two kinds of shopping places, malls and discount stores. Now imagine that a person is familiar with malls but not informed about the existence of discount stores (e.g., my daughter). Imagine that she is shopping for coffee makers in malls, but believes that only malls exist and, consequently, that the price distribution of malls is the entire price distribution for coffee makers. Being a careful (rational) shopper, she obtains a sufficient sample of prices to form a cost-effective estimate of the distribution of prices at malls, $f(P|M)$, and purchases the least-cost coffee maker that she manages to find. However, because of her ignorance, she does not realize that the distribution of prices in discount stores, although perhaps similarly shaped, $f(P|D)$, lies generally to the left (is below) that of the stores in the malls, for example, the conditional minimum expected price at the mall, P_M^e , is above that of the discount stores, P_S^e . *She is unaware that she has learned a conditional probability distribution, rather than an unconditioned distribution.*
- Because she has an unbalanced sample of the distribution of prices among all stores, she not only is ex ante uncertain about the best price she will find, but also makes a biased estimate of the price distribution and, consequently, is prone to make mistakes.
- One likely consequence of ignorance is biased expectations and systematic *mistakes*. Within the finite sampling representation of incomplete information, rationality implies that only nonsystematic mistakes can arise, because an unrestricted domain of sampling allows data about the entire probability distribution of interest to be acquired. Ignorance implies that the underlying model (conditional probability distribution) that informs one's sampling is missing relevant dimensions or the data set itself is constrained in a manner not fully understood. As a consequence, the individual mistakes a conditional distribution for the whole distribution of interest.

- This kind of mistake is impossible in rational expectations–based micro- and macroeconomics analyses, because individuals are assumed to know essentially as much as can be known about the model at the time they make their decisions. Such “fully rational” individuals are assumed (i) to know the general features of the entire distribution relevant for a given decision, (ii) to use all the information possessed to make unbiased estimates of relevant stochastic phenomena, and (iii) to make perfect (rational) use of those estimates.¹ Consequently, on average, their decisions are always correct.
- Individuals who are less than fully rational might make mistakes, insofar as they violate the last two assumptions, but a fully rational individual who did not know the entire probability distribution of interest could not avoid systematic mistakes, except through blind good fortune. Fully rational individuals who are imperfectly informed in this sense *can only form biased estimates*, because the conditional distribution that they know differs from the unconditional distribution that they should know. In contrast, individuals who use finite, but complete samples would make systematic errors only if they were not fully rational. Even a single complete observation is an unbiased estimate of a distribution’s mean and mode. Only ignorance leads rational individuals to systematically draw mistaken conclusions about the world.
- It bears noting that ignorance in the illustration is not equivalent to wrongly assuming that discount stores are part of the same price distribution encountered at the mall. In that case, sampling at both malls and discount stores together with Bayesian updating would eventually disprove the initial hypothesis and the perceived price distribution would converge to the actual. In the case of interest, the person in question remains fundamentally *ignorant* of the *existence* of discount stores, so those stores do not exist as far as that person is concerned and *will never be sampled*.
- Although the above reasoning may seem unfamiliar, even wrong, insofar as it implies the possibility that individuals may repeatedly make mistakes, it bears noting that similar reasoning is often used to criticize research carried out by economists who engage in empirical work. Econometricians are routinely criticized for using only a subset of individuals, markets, time periods, or governments to reach general conclusions. Empiricists in other sciences are also routinely chided for not getting ever more complete data sets.
- The problems evidently feared by critics are not problems associated with sample size, because only a few dozen observations will generally suffice for statistical

inference, but rather implicitly concern the sampling procedure or data limitations. Improving data sets to address these problems requires collecting data about previously neglected variables or from neglected subdomains of the general distribution of interest (other time periods or countries). Critics often suspect that inclusion of such neglected data will *change* the conclusions drawn—not simply reduce estimation error.²

Two Types of Learning

- In addition to differences in the expectations or estimates that can be developed from restricted and unrestricted sampling, there are also differences in the methods by which new knowledge is acquired. The accumulation of personal knowledge through time often combines repetition (increased sampling) with the incorporation of totally new ideas or phenomena into one’s world view (reductions in ignorance). The first sort of learning can be modeled using the conventional statistical (Bayesian) models of learning. However, reductions in ignorance cannot be so readily modeled, which is one reason why ignorance tends to be neglected in economic analysis. Eliminating ignorance involves a quite different process of learning than increased statistical sampling does.

¹ Assumptions (ii) and (iii) characterize two different aspects of the economic definition of rationality: (ii) implies that individuals will not make systematic information processing errors, that is, will form “rational expectations,” whereas (iii) implies that individuals have well-understood and consistent objectives, that is, will maximize utility.

Fox and Tversky (1995) suggest that ignorance may lead individuals to behave irrationally. Experiments indicate that many individuals are more inclined to bet on what they know than on what remains unknown or uncertain. They term this form of risk-averse behavior “ambiguity aversion.”

Of course, notions of rationality extend well beyond economics. For a discussion of various meanings of rationality in the social sciences, see Simon (1978). I. J. Good (1976) provides a nice overview of the Bayesian interpretation of rationality, which differs in significant respects from that of the modern economic one.

² I only consider honest mistakes in the data collection procedure here. Feigenbaum and Levy (1996) discuss how preferences over estimates may affect scientific work.