INTELLECTUAL DEVELOPMENT STATEMENT

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RESEARCH

Although I have worked on different topics in econometrics, a lot of my interest has been devoted to econometric analysis of empirical estimation and testing in structural economic models, and to analyzing statistical problems arising out of these models that are also of general interest. In particular, my past research began with econometric studies of empirical structural models of auctions. Auction models offer an exciting common ground for testing and implementing economic theory using empirical data. They also motivate many interesting problems in econometric theory, which led me into studying many issues that have much broader implications beyond those inherent in auction models. These issues include semi-parametric methods, model selection criteria, likelihood based inference and computation of structural models using simulation tools. While each of these issues provides a challenging and exciting area of research, it is equally fascinating to explore and understand how these questions are motivated from empirical research and how their solutions can be fruitfully used in relevant applied work. In the following I provide a brief overview of my past work, and then discuss some of my current interests and future research projects. Citations of the relevant papers I have written in these areas are all provided in footnotes. I attempt to report on my research program somewhat chronologically in order to illustrate the evolution of my current research agenda.

Past Research

I began my graduate study learning auction theory, but my interest in econometrics grew over time. Therefore my dissertation and my early research focused mainly on the empirical econometric implications of auction theory. In doing so I discovered that many recent development of advanced statistical tools can be not only used effectively to bear out theoretical predictions from field data, but also exploited to sharpen the understanding of auction theories. Through this research process I also obtained a better appreciation of the importance of some deeper issues in econometric theory,
and delved into studying these issues.

**Empirical Analyses of Competitive bidding**

The influential work of Hendricks and Porter (1988, American Economic Review) laid the foundation for empirical studies of competitive bidding in auctions. The structural estimation approach pioneered by Paarsch (1992, Journal of Econometrics) makes a closer connection between equilibrium predictions and econometric models. However, an important issue remains unresolved: how to choose between private and common value models of bidders’ information. This distinction is fundamental in the theoretical literature on auctions, with important strategic and informational implications on the observed bidding data and the design of selling mechanisms.

One implication of this distinction is that multi-stage ascending auctions will generate more seller revenue than single-stage sealed bid auctions when there is a significant common value component in bidders’ valuation, since the multi-stage nature of ascending auctions generates more information revelation and reduces uncertainty and allows the bidders to compete more aggressively. My joint work with Matthew Shum (Johns Hopkins University) developed a formal framework to analyze the relative importance of common value variation in ascending auctions. We began with a theoretical characterization of Bayesian-Nash equilibrium bidding behavior in ascending auction models, which allow for bidder asymmetries as well as common value and private value components in bidders’ underlying valuations. We show that the equilibrium inverse bid functions in each round of the auction are implicitly defined by a system of nonlinear equations, so that conditions for the existence and uniqueness of an increasing-strategy equilibrium are essentially identical to those which ensure a unique and increasing solution to the system of equations. We exploit the computational tractability of this characterization and develop an econometric model based on log-normal distributional assumptions. This extends the scope of the literature on the structural estimation of auction models to multi-round and asymmetric models.

We provide an empirical illustration of this model by estimating it using data from the PCS spectrum auctions run by the U.S. Federal Communications Commission (FCC). We present estimated bid functions that illustrate how equilibrium learning affects bidding behavior during the course

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of an ascending auction. Our empirical results showed significant importance of bidders’ learning behavior during the bidding process and suggested that the ascending auction format provides an effective mechanism for information revelation.

The distinction between common value and private value auction models also generates different predictions on the effect of increasing competition on equilibrium bidding behavior. According to the Walrasian analogy of markets as auctions, an increase in the number of bidders should encourage more aggressive bidding that benefits the auctioneer. While this is true within the independent private-values paradigm, it may not be true at auctions with affiliated signals, an important subset of which are common-value auctions in which the competing bidders are differentially but incompletely informed about the value of the object which they are trying to win. A distinctive feature of common-value auctions is the winner’s curse, an adverse-selection problem which arises because the winner tends to be the bidder with the most overly optimistic information concerning the object’s value. Bidding naively based simply on one’s information would lead to negative expected profits so that, in equilibrium, a rational bidder internalizes the winner’s curse by bidding less aggressively.

In common-value settings, an increase in the number of bidders has two counteracting effects on equilibrium bidding behavior. First, the increased competition generally leads to more aggressive bidding. Second, the winner’s curse becomes more severe as the number of potential bidders increases, and rational bidders will bid less aggressively in response: we call this the winner’s curse effect. If the winner’s curse effect is large enough, prices could actually rise as the number of competitors increases. In joint work with Matthew Shum (Johns Hopkins University)^2, we consider the empirical importance of these considerations using bid data from construction procurement auctions held by the New Jersey department of transportation in the years 1989–1997. First, we examine the importance of common-value components in bidders’ preferences. Second, having found some evidence of common values, we investigate how the winner’s curse affects equilibrium bidding. Our results show that different types of contracts differ substantially in the degree that private- and/or common-value components are important. We find that both common-value and private-value components are important in auctions for highway-work and bridge-repair contracts, while more homogeneous road paving contracts are predominantly private-value auctions. These

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results indicate that the winner’s curse effect is particularly strong in highway-work auctions. Moreover, winning bid simulations indicate that the average procurement cost is strictly increasing in the number of bidders as competition intensifies. Clearly, cases exist where the “law of demand” is violated: an increase in competition leads to higher procurement costs. In addition to the empirical findings, we also develop a new estimation method for auction models by exploiting the quantile invariance properties of monotonic bidding functions, which is similar in spirit to the pioneering work on semi-parametric nonlinear quantile estimation by Powell (1984, Journal of Econometrics). This facilitates estimation of many nonlinear auction models that are computationally difficult to analyze.

These empirical findings also motivate a theoretical investigation of the magnitude of the winner’s curse when the number of bidders increases without bound. The theoretical literature on common value auctions has much emphasized and studied the role of price as an explicit mechanism for aggregating private information dispersed among individual bidders, and has shown that the winner’s curse effect decreases when the number of bidders increases without bound. Indeed, the market price aggregates information, in the sense that it converges in probability to the true unknown common value of the object as the number of bidders grows large (see, for example, Pesendorfer and Swinkels (1997, Econometrica)). However, no results exist as to the rates at which prices aggregate information, and how they differ across different forms of auctions. In a subsequent paper, we derive the convergence rates of prices in sequences of common value auctions of different forms. This provides a much more precise understanding of the informational content of the market price when the number of bidders is large but finite. Moreover, we uncover important differences in the informational features of the prices across different auction mechanisms which may be overlooked when focusing just on information aggregation itself. We find that different auction mechanisms typically are associated with different rates of convergence, which often reflect differences in their underlying economic forces which generate information aggregation. Our result shows that in auctions in which information aggregation is driven by the winner’s curse, a reduction in demand intensifies the winner’s curse and therefore increases the rates of convergence. On the other hand, in auction in which information aggregation is driven by the balance between the

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winner’s curse and the loser’s curse, a better balance between supply and demand increases the convergence rates. Interestingly, we also discover the surprising result that the extra information reflected in the prices of the ascending auction cannot improve upon the rates of information aggregation obtained in simultaneous seal bid auctions. These theoretical insights that we derived in the paper can be overlooked if one focuses just on whether information aggregation occurs, and not on the convergence rates of the prices.

*Semi-parametric Estimation and Testing Methods*

Most of my previously mentioned papers are based on using parametric models with auction data. While they provide sharp predictions for policy implications, their lack of robustness against potential mis-specification has also been much criticized. The need for a better understanding of the consequence of mis-specification and the quest for possible remedies have lead me to study and investigate semi-parametric and non-parametric methods, which have become increasingly popular in the recent econometric literature. My first paper on these topics is a result of my collaboration with Elie Tamer (Princeton University), in which we studied linear regression models with censored outcome variable and endogenous regressors\(^4\). Endogeneity arises frequently in linear econometric models. Prominent examples are the simultaneous equation model and the measurement error model. Censored linear models with endogenous regressors have important economic applications. For example, in studying the returns to education, the regressor of education level is typically suspected to be endogenous, and the dependent income variable can be top coded in data. Existing methods for inference in censored models in the presence of endogeneity are based on the explicit parametrization of the endogeneity using distributional assumptions. The recent paper by Blundell and Powell (2000) contains the latest developments in the literature on nonlinear semi-parametric regression models using a control function approach. In contrast, in our paper we use a minimalist approach. We only make a semi-parametric assumption that there exists a set of instrument variables such that given the instruments, the error terms in latent linear regression function have zero medians. When the outcome variables are censored, we exploit this zero conditional median assumption to obtain inequality restrictions on the regression function and derive identifiable features of the regression coefficient parameters, using the principles laid out in Manski\(^5\).

and Tamer (2002, Econometrica). We view the censored model as an incomplete model due to
the inability of the researcher to obtain more precise information about the outcome variable. We
use a minimum distance estimator to consistently estimate the identified features of the model,
the later being either a set or a point. In our paper we provide sufficient conditions under which
the coefficient parameters are point identified. We also show that the minimum distance estimator
we proposed is consistent and asymptotically normally distributed, thus allowing for feasible and
practical statistical inference using our proposed method.

Computational issues are as important as theoretical ones in censored linear regression models.
In joint work with Victor Chernozhukov (Massachusetts Institute of Technology)\(^5\), we studied a
computationally attractive variant of Powell’s (1986, Journal of Econometrics) censored quantile
regression estimator. By imposing weak additional envelope and separation restrictions on the
censoring probability, we provided a simple, easily implementable, and well-behaved three step
estimation procedure. These restrictions preserve the plausible semi-parametric, distribution-free,
and heteroscedastic features of the model. We also illustrate the estimation procedure with a
re-evaluation of the famous Redbook dataset on extra-marital affairs.

Equipped with a deeper understanding of semi-parametric and non-parametric statistical methods, I
began to inquire their applications in structural empirical models of auctions. In joint research with
Phil Haile (University of Wisconsin) and Matthew Shum (Johns Hopkins University)\(^6\), we develop
non-parametric tests for distinguishing between common value and private value paradigms based
on observed bids at first-price sealed-bid auctions. These tests rely only on behavioral predictions
from economic theory and do not require any ad hoc parametric assumptions. The importance of
such tests for empirical research on auctions is emphasized by recent results showing that common
value models are identified only under strong and untenable conditions on the underlying information
structure or on the types of data available. Hence, a non-parametric method for determining
whether a common value or private value model is more appropriate could play an important di-
gnostic role for researchers hoping to use demand estimates from bid data to guide the design

\(^5\)Chernozhukov, V. and H. Hong, 2002, “Three-Step Censored Quantile Regression and Extramarital Affairs,”

\(^6\)Haile, P. and H. Hong and M. Shum, 2002, “Nonparametric Tests for Common Values In First-Price Sealed-Bid
Auctions,” working paper.
of markets. Our tests exploit variation in the number of bidders and are based on detecting the effects of the winner’s curse on equilibrium bidding. The winner’s curse is an adverse selection phenomenon arising in common value but not private value auctions. Relying on this distinction, our testing approach is based on detection of the adjustments rational bidders make in order to avoid the winner’s curse. This is nontrivial because variation in the level of competition affects the aggressiveness of bidding even in a private value auction. However, economic theory enables us to separate this competitive response from responses, if any, to the winner curse using non-parametric methods. Our statistical tests involve stochastic dominance relations of the distributions of bidders’ expected values of winning in auctions with varying number of bidders. These expected values are estimated using the non-parametric methods of Guerre, Perrigne and Vuong (2000, Econometrica) and Hendricks, Pinkse and Porter (2002, Review of Economic Studies). Our testing problem is complicated by the fact that we are comparing empirical distributions of bidders’ expectations that are themselves estimated. We develop new distributional results for stochastic dominance tests in the setting of our models.

Models of Measurement Errors

Empirical analysis of auction data, as in empirical analysis of other types of economic data, can produce misleading results if a significant amount of measurement error is present in the data set and is not properly accounted for. I became increasingly interested in methods for handling measurement errors in nonlinear econometric models as I became increasingly aware of the prevalence of measurement errors in economic data.

Many existing estimators for handling measurement errors in nonlinear models are difficult to implement and also require additional data such as repeated measurements of the error-ridden variables. In joint work with Elie Tamer (Princeton University)\(^7\), we propose a simple estimator for nonlinear method of moment models with measurement error of the classical type when no additional data is available. The measurement errors are independent of the latent variables and are independent of each other. We base the estimation method on the assumption that marginal distributions of the measurement errors are Laplace, or double exponential with zero means and

unknown variances. Under these assumptions, we derive simple revised moment conditions that are expressed in terms of the observed variables. They are used to make consistent inference about the model parameters and the measurement error variances. The estimator we propose is a parametric method of moments estimator that uses the revised moment conditions and hence is simple to compute. More importantly, it is particularly useful in situations where no additional data is available, which is the case in many economic data sets. A simulation study demonstrates good finite sample properties of our proposed estimator, and acceptable behavior under mis-specification of the measurement error distribution.

Another concern with many error-ridden economic data sets is the potential correlation between the measurement errors and the underlying true unknown variables of interest, a phenomenon well documented in the empirical literature. Such correlation violates the classical assumptions and invalidates many conventional solutions for measurement error models. To address this issue, in a joint paper with Xiaohong Chen (New York University) and Elie Tamer (Princeton University)\(^8\), we study the problem of inference about a parameter defined in terms of possibly nonlinear moment conditions when the data is measured with error, and we allow for arbitrary correlation between the mismeasured variables and the measurement errors. To solve the identification problem, we require the existence of an auxiliary data set that contains information about the conditional distribution of the true variable given the mismeasured variable. Our main assumption requires that the conditional distribution of the true variables given the mismeasured variables is the same in the primary and auxiliary data. Our methods allow the auxiliary data to be a validation sample, where the primary and validation data are from the same distribution (as in L.F. Lee and J.H. Sepanski (1995, Journal of the American Statistical Association)), and more importantly, a stratified sample where the auxiliary data set is not from the same distribution as the primary data. We show how to combine the two data sets to obtain a feasible semiparametric estimator of the parameter of interest. We study the large sample properties of the sieve based estimator and derive its asymptotic distribution. When the auxiliary data set is also a validation data set, we demonstrate the efficiency gain from combining the primary data set with the auxiliary data set. We also illustrate our methods by estimating a return to schooling regression using the CPS/SSR 1978

exact match files. We find that our estimator method gives very different results for the return to education and the return to experience than the least square regression using either the primary data set alone or the auxiliary data set alone. This suggests that the presence of measurement error in income might be an important empirical issue.

**Current Research and Directions for Future Work**

In the past year much of my effort has gone towards opening up new and broader research directions. These directions include simulation based computation and statistical inference methods and techniques for selecting between various econometric models.

*Monte Carlo Simulation Approach to Statistical Estimation*

Many parametric and semi-parametric econometric estimators, including the previously discussed ones, are defined as optimizers of random sample objective functions. These criterion functions can be highly nonlinear, non-convex and non-smooth with many local optima. Optimizing these functions is known to be very difficult and presents a formidable practical challenge. While recent development in empirical process theory can be used to analyze the statistical properties of these estimators, the computational problem remains daunting in many applications.

To address these issues, my joint project with Victor Chernozhukov (MIT)\(^9\) studies the statistical properties of an alternative class of estimators which we refer to as Quasi-Bayesian estimators. They are obtained by transforming any given statistical criterion function into a proper distribution, or quasi-posterior distribution over a parameter of interest and defining various moments of that distribution as point estimates. These estimators minimize globally convex objective functions and can be practically computed using a variety of Monte Carlo Markov Chain simulation techniques from Bayesian statistics. We show that this approach yields both computable and theoretically attractive alternative estimators for many existing parametric and semi-parametric models in the literature.

We also investigate the formal statistical properties of these estimators, and establish root-\(n\) consistency and asymptotic normality properties under general conditions in regular models. These

results hold under general stochastic equi-continuity conditions, which cover most extremum estimators in the literature and allow discontinuous, non-smooth semi-parametric criterion functions and general data generating processes. We verify these conditions for semi-parametric extremum estimators, generalized method of moment estimators and generalized empirical likelihood based estimators. In addition, we formally show that under a generalized information matrix equality condition, the quantiles of the quasi-posterior distribution provide asymptotically valid confidence intervals and can be effectively used for the purpose of classical statistical inference. We conduct a simulation study which demonstrates desirable finite sample properties of both the point estimates and the coverage properties of the quasi-posterior confidence intervals.

Likelihood Inference in Non-regular Econometric Models

In addition to computational difficulties, many empirical structural econometric models, including auction models and equilibrium job search models, share the interesting feature that the support of the distributions of the observed dependent random variables depends on model parameters. This violates the regularity conditions required for asymptotic normality of maximum likelihood estimators (see, for example, Donald and Paarsch (1996, Econometric Theory)). An open question in this area is the large sample properties of likelihood based estimators when the covariates have a continuous distribution. In a joint paper with Victor Chernozhukov (MIT)\textsuperscript{10}, we study this question. We generalize these models to a conditional model with a jump in the conditional density, whose location and size are described by regression lines, and develop the asymptotic theories of Bayes and Maximum Likelihood estimators for this general model. Both Bayes and Maximum Likelihood estimators are attractive estimation procedures in this model. While the Maximum Likelihood estimator is transformation invariant, the Bayes estimators offer some theoretic and computational advantages. They also have desirable efficiency properties. Our results show that the limit of the likelihood ratio process is a stochastic integral of a Poisson Point process, and that both Bayes and Maximum Likelihood estimators behave asymptotically as functions of this stochastic integral process. Unlike the usual case of regular parametric models, Bayes estimators are not asymptotically equivalent to the Maximum Likelihood estimator. These results provide useful and practical inference tools in empirical applications of these models. In simulations we


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also study the finite sample properties of using simulation and resampling techniques to implement inference methods.

**Model Selection and Testing**

Methods for selecting and testing between competing econometric models provide valuable diagnostic tools for empirical estimation results, including many of the auction models discussed above. When the competing models are all parametric, Akaike and Bayesian types of model selection criteria and Vuong’s (1989, *Econometrica*) likelihood ratio tests for non-nested models have been used extensively in applied research. In practice, however, many estimators are based on semi-parametric unconditional moment conditions. Even for parametric models maximum likelihood estimators can be computationally difficult and generalized method of moments have been frequently used instead. Kitamura ("A Likelihood Based Approach to the Analysis of A Class of Nested and Non-nested Models", 2002, working paper) proposes an innovative non-parametric information-theoretic method for model comparisons involving conditional moment based models. Additional difficulties of model selection and testing arise when more than two method of moment models are involved or when the competing models are estimated using different methods. I study these issues in another current research direction.

In a paper joint with Bruce Preston (Princeton University) and Matthew Shum (Johns Hopkins University)\(^{11}\), we propose model selection criteria for unconditional moment models using generalized empirical likelihood (GEL) statistics. These model selection criteria seek to minimize the GEL statistics modified by a penalty function that rewards use of additional correct moment conditions for a given number of parameters and penalizes less tightly specified models for a given number of moment conditions. The use of generalized empirical likelihood statistics in lieu of the J-statistics proposed by Andrews (1999, *Econometrica*) leads to an alternative interpretation of the model selection criteria by emphasizing the common information theory based rationale underlying model selection procedures for both parametric and semi-parametric models. If there is at least one model that is correctly specified, the GEL based model selection criteria choose the most parsimoniously specified model among correctly specified models, with probability converging to one. If


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all models are mis-specified, our proposed model selection criteria choose the model that minimizes the penalty-augmented GEL statistics. The GEL based moment selection criteria facilitate choice among multiple competing moment condition models. The results of a simulation study suggests that the GEL based model selection criteria can be a useful alternative to the J-statistics based model selection criteria.

Between two competing empirical models, it often arises that one model can be efficiently estimated using parametric models while the other one can only be feasibly estimated using generalized method of moments underlying data generating process. In current joint research with Xiaohong Chen (New York University) and Matthew Shum (Johns Hopkins University), we study this issue and propose model selection tests where the alternative models can consists of a fully parametric model versus a semi-parametric model defined via unconditional population moment conditions. These tests are directional and apply to situations in which the two models are non-nested, overlapping or nested. Currently we are investigating the large sample properties of these tests, and considering possible empirical applications.

In conjunction with my continuing interest in the empirical and theoretical challenges provided by many structural econometric models, I have also touched briefly upon several subjects that are not mentioned in one of the above topics of my past and current research. In a joint project with Matthew Shum (Johns Hopkins University), we study a new estimation method for dynamic optimization models with unobserved state variables that is semi-parametric and does not require parametric assumptions about the distribution of these unobserved state variables. We are also applying some of the above mentioned results on generalized empirical likelihood based model selection methods to study the implications of competing theoretical models of consumer search behavior on consumer search costs using online price dispersion data. While these research projects are still in a very early stage, they can potentially lead to fruitful and interesting results in the future.


\footnote{Hong, H. and M. Shum, 2002, “A Semi-parametric Estimator for Dynamic Optimization Models, with an Application to a Milk Quota Market,” work in progress.}

TEACHING

I have taught in the Department of Economics in Princeton University in the academic years 1998-1999, 1999-2000 and 2001-2002. I am also currently teaching in Princeton for the academic year 2002-2003. During the academic year 2000-2001 I was on leave as a visiting scholar in the Institute for Economic and Social Research in Universite Catholique de Louvain in Belgium, during which I performed no teaching duties. The courses I have taught are mostly courses in econometrics and statistics.

I consider teaching to be both a privilege and a great responsibility. I derive a deep satisfaction and a sense of fulfillment from teaching in the classroom and from course development. When I first started working as a teaching assistant during my graduate study, I understood that I came in with two handicaps. First I was not educated in an American university. Second I was a non-native English speaker. But I believe that effective teaching is an art that one learns through practice. So I resolved to learn how to become an effective teacher and sought ways to improve myself. I believe my years of effort, ever since my first experience as a teaching assistant in graduate school, have paid significant rewards in my teaching. To me, teaching is not a one-way street: teaching also affords me the opportunity to learn from both the students and the experience of teaching itself.

The courses I have taught are econometrics and statistics courses, at both the undergraduate and the graduate levels. The courses are technical by nature and they provide students with skills necessary to conduct quantitative empirical research in economics. The major difficulty in teaching statistics and econometrics comes from the necessity of striking a balance between the great volume of quantitative knowledge required to conduct high quality empirical research and the economic intuition hidden behind the technicalities. Well-organized lectures with substantial coverage of a vast range of knowledge are good starting points for a rewarding class. Of course it is often too much to expect that all, or even a majority of students will absorb the most difficult material adequately through reading and lecture alone. I encourage students to attend my office hours, and make additional appointments for those whose responsibilities conflict with scheduled office hours. I also encourage students to work together, to share their ideas, and to learn from each other.

I believe the most effective way of learning is learning by doing. Therefore well-designed homework problems provide important intellectual challenges to students and push the envelope of their
understanding of the intuition behind quantitative materials. Students may not always be pleased by the challenge of problem sets, but they will benefit from the process of active thinking and discovery. It is also my view that exams are used to test students’ understanding of economic and statistical intuition, and not to test their rote memory of dry formulas. Therefore all my exams are open book and open notes. To accommodate the varied backgrounds and abilities of students, the exam questions are carefully designed to reflect students’ different levels of understanding of course materials.

Graduate Teaching

I have taught the following graduate courses: ECO 519 (Advanced Econometrics: Nonlinear Models) in the spring semesters of 1999 and 2000, ECO 518 (Econometric Theory II) in the spring semesters of 1999, 2000 and 2002 (I taught the course jointly with Professors Bo Honore and Elie Tamer in 1999 and 2000). I am currently teaching ECO 517 (Econometric Theory I) for the fall semester of year 2002.

ECO 519 (Advanced Econometrics: Nonlinear Models) is a second year upper graduate level elective course in microeconometrics. The course covers nonlinear statistical models for the analysis of cross-sectional and panel data. Approximately half of the course is devoted to the development of large-sample theories for nonlinear estimation procedures, while the other half aims at introducing students to the latest developments in econometric techniques and their applications to various econometric models. Most often, students take this class both to learn the most cutting-edge econometric tools to use in their applied research, as well as to gain the tools to pursue research topics in theoretical econometrics. The students I taught in this class are a small group of extremely motivated and dedicated students who are potentially outstanding researchers and field leaders in the future. Two students from this class are currently faculty members in the Department of Economics in Duke (Barbara Rossi and Alessandro Tarozzi). Currently I am on the dissertation committees of three other students from this class. Among them, two are outstanding theoretical econometricians and are recognized by our department as among the best students of our current graduating class of Ph.D. candidates. One of the most rewarding aspects of teaching this class is the opportunity to learn from these students. Some of them are more knowledgeable and better trained than I am in other areas of economics, and I learn from them through their questions and
challenges, just as they learn from me through my lectures and assignments. In fact, one of my research papers about model selection criteria (see footnote 11) is a joint paper with Bruce Preston, who was a former student in this class and who is now recognized as the best macroeconomist among our current graduating class of Ph.D. candidates. Even though Bruce and I work in different areas and I do not serve as a member of his thesis committee, we discuss and exchange research questions and ideas, which has led to the result of a fruitful joint paper.

ECO 518 (Econometric Theory II) is a second semester first year required core econometrics course for graduate students. The purpose of the course is to provide students with a broad set of statistical tools, which they can use to pursue top quality quantitative empirical work in their chosen fields of dissertation research. This course begins with extensions of the linear regression model in several directions: pre-determined but not exogenous regressors; heteroskedasticity and serial correlation; classical generalized least squares; instrumental variables and generalized method of moments estimators. Applications include simultaneous equation model, pooled cross sectional and panel data, vector auto regression and non-stationary time series models. Building on the foundation of linear models, estimation and inference in nonlinear models are introduced and discussed. Applications of nonlinear models include nonlinear least squares, discrete dependent variables, problems of censoring, truncation and sample selection, and models for duration data. Students are also exposed to the recent development in nonparametric kernel density estimation and resampling methods of statistical inference. The course also aims at offering an overview and intuitive discussion of the theoretical foundations underlying many operational aspects of the econometric toolkit. While the majority of students only use the tools they learn from this class in their future empirical research, students who are inspired by the theoretical foundation underlying this core course usually proceed to take the second year advanced econometric sequence, including ECO 519. Indeed, all the students in my spring 2000 ECO 519 class come from the spring 1999 ECO 518 class. Many of them appreciate the depth and extensive coverage of the course material despite its technical difficulty.

ECO 517 (Econometric Theory I), the course I am currently teaching, is a first year first semester required core econometrics course for graduate students and is a prelude to ECO 518. Professor Chris Sims taught the first half of the course while I am currently responsible for the second half of the course. The second half of the course introduces students to large sample asymptotic
distribution theory and uses it to develop the finite sample and large sample distribution results for ordinary least square estimators. It then proceeds to relate maximum likelihood estimation with ordinary least square regression, and analyze information matrix test and tests for conditional heteroscedasticity. Some students are better prepared than others. The goal of the class is to stimulate the better-prepared students to pursue a deeper perspective and to consolidate their knowledge, while allowing for other students to gain the technical background they need to continue their graduate study successfully. I choose to deemphasize the regularity conditions and the proof of technical results, but instead emphasize how these results can be used in applied work and stress the empirical contents of the abstract distributional theorems. This is certainly a direction welcomed by the students.

*Undergraduate Teaching*

I have taught ECO 306 (Econometrics: A Mathematical Approach) during the Spring semester of 2002. Currently I am teaching ECO 200 (Statistics and Data Analysis for Economics) for the Fall semester of 2002.

ECO 306 (Econometrics: A Mathematical Approach) is a second undergraduate level course in the statistical analysis of economic data. It is offered in parallel to ECO 303 (Econometrics). ECO 303 is the non-mathematical version of the same course, while ECO 306 is oriented towards more quantitatively inclined students. Both are required core courses for economics majors. ECO 306 introduces students to the use of econometric methods for estimating economic relations, testing economic theories and evaluating and implementing government and business policy. It begins with simple regression models and multiple regression models, and presents techniques for dealing with violations of the regression model’s assumptions, including autocorrelation, heteroscedasticity, specification error and measurement error. Subsequently it introduces simultaneous equation models and the instrumental variable estimation method. It concludes with applications to dummy variables, discrete choice models and time series modeling and forecasting. While the course title contains the phrase ”mathematical approach”, I did not consider it to be a course of tedious and monotonous derivations of technical results. Instead I emphasize the statistical and economic intuition inherent in the mathematical statements, and emphasize the importance of understanding formal statistical models in order to interpret empirical economic analysis in a coherent and
convincing manner. The course also emphasizes application of econometric methods to various economic issues, including forecasts of macroeconomic variables, studying the effects of political campaign expenditures on voting outcomes, and studying the effect of school spending on student performance. The course also involves extensive use of computers, in which students learn to use statistical software packages to perform data analysis and conduct empirical research.

ECO 200 (Statistics and Data Analysis for Economics), a course I am currently teaching, is a core requirement for economics majors and is a prelude to ECO 303 or 306. It introduces students to the concepts of probability, sample space, random variables, probability distributions, statistical estimation and hypothesis testing. The regression model is also first introduced. This is a large class and the students of this class come from a wide variety of backgrounds. I have experimented with a new lecturing technology using on-site computer projection of power point slides. The slides are made into handouts and are always posted on a course web page, so that students can always download them before the lecture. This also allows me to demonstrate the use of computer statistical softwares. Students commented that the handouts have helped them tremendously in reading and in understanding the lectures. To accommodate the needs of a large number of students, I offer extensive office hours and also interact with them through frequent email exchanges. The concepts from each chapter are demonstrated using a real empirical data set. Students obtain hands on experience using the software programs such as Excel and Stata to analyze these data sets and to digest the statistical concepts they learn from the textbook and from the lectures. These features are helpful in making learning statistics a more enjoyable and satisfying experience.
SERVICES

Outside Academic Appointments

During the academic year 2000-2001 I was a visiting professor in the Institute for Economic and Social Research (IRES) in Universite Catholique de Louvain in Belgium. This visiting position is funded by a research fellowship from Universite Catholique de Louvain and by a supplement grant from the Dean’s office of Princeton University.

Service to Princeton University

I have served twice in the junior faculty recruiting committee for the Department of Economics of Princeton University in the academic years 1998-1999 and 2001-2002. This has provided me with opportunities to contribute to the development of the intellectual environment of the department and the university by identifying and actively recruiting the most outstanding Ph.D. candidates in Economics on the job market. During these two years the effort of our recruiting committees has successfully brought in five new colleagues to the department who are now actively contributing to the department’s academic environment. In addition, I also find this a great occasion to meet many fellow researchers, to learn from the many younger scholars and to learn from other disciplines within Economics.

I have also served three times as the seminar organizer for the Oskar Morgenstern Memorial Seminar of the Gregory C. Chow Econometrics Research Program, in academic years 1998-1999, 1999-2000 and 2002-2003. Planning and organizing several semesters’ successful seminar sequences was one of my most gratifying and memorable experiences in Princeton. Our seminar speakers range from well known established senior econometricians to talented young scholars and researchers, including some of our own graduate students. The day visits by seminar speakers, including the seminar itself and the interaction between the speaker and faculty and students, have become an integral part of the department’s weekly academic activities.

Another area of my service to the department is tied to my research and teaching. I am currently a member of three doctoral dissertation committees. The students I am co-supervising are Debopam Bhattacharya, Aprajit Mahajan and Wako Watanabe. All of them are going on to the job market this year. The first two are recognized by our department as among the best of our graduating
Ph.D. students. I co-authored a paper with another student of the graduating class, Bruce Preston. In the past I have sat on the defense reading committees of two former students, Luojia Hu and Steve Wu. In addition I have supervised more than a dozen undergraduate senior theses in the past few years, and am currently supervising a junior independent work.

Beyond the above formal engagements, I have tried to contribute to the academic enterprise in informal ways on a day-to-day basis. Together with my colleagues Professors Bo Honore and Elie Tamer, we organized an econometrics student workshop, in which students are encouraged to present their work in progress and their very preliminary research ideas. Many of these presentations have later become the basis of their dissertation research. Currently I am also organizing an informal reading group among first and second year graduate students to study advanced econometrics topics that are not covered in our sequence of econometrics course offerings. In addition, I do my best to assist students with their technical and quantitative problems, through many hours of discussions with them in my office and through responding to their numerous email messages. As a responsible member of the department, I contribute regularly to the graduate economics club of our department, attend almost very all department faculty meeting and many other informal meetings, and participate actively in discussions of issues relating to the department’s teaching and research activities.

_Service to the Discipline_

I have served as a referee for more than ten leading professional economics journals: Econometrica, Review of Economic Studies, Journal of Econometrics, Econometric Theory, Journal of American Statistical Association, Rand Journal of Economics, Review of Economics and Statistics, Computational Statistics, The Econometrics Journal. I have also refereed three funding proposals for the National Science Foundation. I regularly attend and contribute to professional conferences as either paper presenter or as discussant. These include many north American Econometric Society summer and winter meetings, the world congress of the Econometric Society, and numerous more specialized professional meetings such as the Stanford Institute of Theoretical Economics, the European conference series in Econometrics, and many others. I have also presented my research in more than thirty leading universities in the Unite States, Canada and Europe.