



Department of
Economics
Queen's University

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QED

The QED, like other highly-ranked Canadian departments of Economics, faces serious challenges. As university budgets in Canada have been cut, those in the United States have been increasing. The result has been a growing differential in the salaries of academics in Canada and those south of the border, especially in the field of Economics. This has led to the flight of first-rate economists. At Queen's we have retained many of our outstanding faculty and in the last few years have hired some excellent young economists; but maintaining our stature in the face of these losses has been difficult (twelve of our faculty, who left Queen's over the past ten years, are now teaching at U.S. schools).

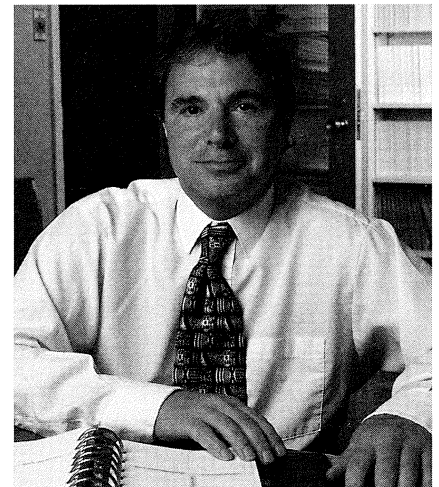
The Department hopes to deal with the problem by establishing endowed Professorships, or possibly a Chair. These are widely-used at U.S. universities to retain and attract exceptional faculty. At Queen's, Professorships with an endowment of \$800,000 could provide the financial support that would allow us to hold on to and attract the excellent teachers and researchers who, along with our students, have been the basis of our reputation. The **Douglas D. Purvis Professorship in Economics** currently has over \$450,000 in its endowment fund, but we are still short of our goal. As well we would like to establish two more Professorships over the next few years.

The QED has maintained excellence despite the cut-backs. In the last *Social Sciences and Humanities Research Council* competition, seven of our faculty were awarded three-year research grants, a success rate of nearly 80 percent. Enrolment in our undergraduate rose by more than 20 percent in the last two years, and we continue to have an active graduate program. We have graduated over 200 PhDs, and have consistently ranked among the

best Departments in North America in the placing of our students in academic jobs.

The **Institute for Economic Research** (IER) has been a key element in the success of the Department. In addition to financing our Discussion Paper series and making available funds for distinguished visitors to lecture at Queen's, the IER provides much needed support to students. Establishing Professorships and strengthening the IER will help the QED continue its record of achievement. If you would like information about either of these initiatives please write, fax, phone, or e-mail.

In this Insert we deviate from the usual *Newsletter* format. Here we report on the research of two of our faculty members. Alan Green talks about his work on the immigration point system, and James MacKinnon describes a bootstrapping technique that he developed with Russell Davidson.



Frank Lewis was Acting Head of the Department in 1997/98 while Lorne Carmichael was on sabbatical in Australia (University of Melbourne) and New Zealand (University of Auckland).

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Alan G. Green, Professor Emeritus (BAH, Queen's; Ph.D., Harvard), retired in 1997 after many years of distinguished service to the Department, the University, and the Economics profession. In addition to his work in Economic History, mainly in the area of immigration, Alan has written numerous papers on the mining industry, many co-authored by his wife, Ann Green. Here Professor Green talks about his and David Green's paper on the immigration point system. The Canadian Journal of Economics awarded it the Harry Johnson prize for 1995, honouring the best article to appear that year.

QED First I want to congratulate you and David for winning the Harry Johnson Prize.

AG Thank you very kindly, we were pleased and surprised to win the award.

QED Of course David graduated with an honours degree in Economics from Queen's (BAH 84) and he is now teaching at UBC. So there is really a double Queen's connection.

AG Absolutely, he graduated here with an Honours degree as you said and with the medal in Economics (Ed.: Alan won the medal in 1957).

QED I had forgotten that. I also noted, with pride, that in the same *CJE* issue where your prize was announced – the prize for 1996 was also reported and the winners in a co-authored paper were Herb Emery and Ken Mackenzie. Herb graduated with an honours degree in Economics from Queen's (BAH 88) and Ken is one of our Ph.D. graduates (PhD 90). Both are now teaching at the University of Calgary.

AG I especially remember Herb not least because he was a PhD student of David's at the University of British Columbia. That's one carryover between the two of us; the second is he also works with his father, George Emery, on research projects. They are jointly writing a book on the role of fraternal organizations and are a little further ahead than David and I.

QED What is your book going to be on?

AG All of the articles on immigration. The work we have and are doing is building towards a history of eco-

nomics and immigration in Canada in the 20th Century. That is where all of this is ultimately going.

QED Thinking about these father-son teams, maybe there's something about a Queen's education that brings families together.

AG Outside of paying the bills, I don't know what it is.

QED You have worked with many different coauthors over the years including your wife, Ann Green. How has working with David compared?

AG Well, it was certainly an easy working relationship. We started as you might well know doing our first article, which was published in *Explorations of Economic History*, on immigration into Canada in 1912 using the sample from the ships' manifest for that year. The sample itself was drawn by Ann as part of the work on her M.A. thesis, which unfortunately she didn't complete. She gave that sample to David, and David and I used that to pull together our first piece of work. It was a desire on our part to work together and to use that sample to produce an article. So it has been an easy working relationship right from the beginning.

QED I've seen you give seminars together. There seems to be a clear division of labour. You tell the stories but when the discussion turns to the nitty gritty of say the problems with heteroscedasticity or multicollinearity your eyes seem to glaze over and David springs to life.

AG You're absolutely right. We are perfect Adam Smithians, we have the division of labour clearly defined. I do the institutional background history

and David does the technical and econometric work. It seems to have worked out very well.

QED Turning to the paper that won the Harry Johnson prize and which you and David have summarized in our *QED Newsletter and Beyond* (that's for CBC Radio Two listeners). You've been interested in immigration for quite a number of years. I'm sure many readers of this Newsletter will have been exposed to your 1976 book on post-war immigration. And more than a few of them, I imagine, are aware of your work on early 20th-century immigration to Canada. But how did you come to write a paper on the point system?

AG As I say, David and I have a long-run project in mind, focussing on the history and economics of immigration to Canada in the 20th Century. We decided to take a look at the composition of the inflow into Canada, and that started the process of trying to explain why there has been such a dramatic change in the skill composition of immigrants over the last decade. It was at that point that we began to pull the paper together and ask ourselves what role did the point system, that is used to evaluate potential immigrants, play in the changing occupational and skill composition of immigrants coming into Canada. That was really the basis - how do we explain the changing skill composition of arrivals?

QED Were there any particular surprises that came out of the analysis? You seem to get very strong results.

AG The most surprising result, as I suggested a minute ago, was the sharp decline in skill levels over the last decade. We expected that when immigration rebounded after 1984 we would probably see the skill composition go back up again. Instead the whole policy had shifted away from an economic basis towards humanitarian and family reunification. That shift, along with a change in source countries, had a dramatic effect on the quality of immigrants defined in terms of their skill levels. The point system worked, but its effects were swamped by these other factors.

QED It is rare that an academic paper has an almost immediate effect on public policy but when it has happened, at least in the Canadian context, more often than not Queen's economists have been

involved. I think back to the early 1980s and the MacDonald Commission. David Smith (Head of the Department at the time and later Principal of Queen's) oversaw the economics section. Parts of their report, especially those written by Queen's economists, including Richard Harris, helped persuade the Conservative government to pursue a free trade agenda with the United States.

AG Well in our case, I don't know whether we had such a direct link.

QED Certainly your work on the immigration point system was widely reported in the press, and seems to have had an impact already on the Canadian immigration policy. I wonder if you could comment on your involvement in these changes.

AG Well one never knows what impact your work is going to have. We stressed from the beginning in this paper and in other presentations that the policy the government was following in the early 1990s was a major diversion from the past position of Canadian governments, especially with respect to immigrant skills. And we hoped that our paper would suggest to them that they should bring a better balance between humanitarian and family reunification, and the independent immigrants, who are judged on the basis of skill, and that skill become a more important component. Since the mid-1990s government policy has indeed swung in that direction. We are very pleased in the way they are managing the inflow now versus the way it was just five or six years ago.

QED So you think immigration policy is moving in the right direction.

AG We think it is. And, on another note, we have just finished a paper in which we question whether government has clear goals for immigration as we head into the 21st Century. In fact we have started another dialogue with them on what these goals should be.

QED Well, congratulations again. You officially retired last year, but unofficially we managed to persuade you to continue teaching (I think your teaching load may even have gone up). We are grateful to you for that.

AG Well thank you, I enjoy still being a member of the Department.

Canadian Immigration Policy: The Effectiveness of the Point System and other Instruments*

Our central concern was to examine how changes in Canadian immigration policy affected the occupational composition of immigrants. To study this we focussed on the regulatory system developed in 1967. It was in 1967 that the point system was introduced as a means of screening the acceptability of prospective immigrants. This was a major innovation in regulatory arrangements and provided us with an objective measure to test the effectiveness of policy in shaping the immigrant flows. Indeed it is the structure of the 1967 regulations that continues to define current policy.

The primary objective of these regulations was to link immigration directly to the labour force needs of the economy. To meet this goal the government developed the point system. Specific points were awarded to such criteria as education, age, skills, and occupational demand. Most importantly, the greater the shortage in particular occupations, the more points were awarded. Occupations that had high rates of unemployment received no points. To be admitted the prospective immigrant had to score at least 50 out of a possible 100. But the scheme applied to only to **Independent Applicants (IPAS)**, those with no relatives residing in Canada.

There were three other classes of immigrants set out in the regulations. **Sponsored Immigrants** had to be a close relative such as a spouse or dependent child of a Canadian resident. Prospective immigrants in this class entered solely on the basis of kinship. After 1978 they were called **Family Class** immigrants. **Nominated applicants** were more distant relatives. They were assessed under the point system, but if they failed to meet the minimum required for admission, they were given bonus points. The final class, **Refugees**, were admitted under separate provisions.

By varying the processing priorities among these four groups – the IPAS, Sponsored, Nominated or Refugee classes – the government could influence the composition of immigrant arrivals. Beginning in the 1980s there was a shift in policy that continued into the early 1990s, whereby increased processing priority was given to

Sponsored, Family Class, and Refugee applicants. The IPAS, those evaluated according to the point system, became the residual group processed for admission.

This policy shift, as well as a change in the allocation of visas across countries, had a potentially important influence on the occupational distribution of those admitted to Canada. This distribution was important since the basic thrust of policy from the early sixties has been to attract skilled labour to this country and discourage the immigration of unskilled workers. Our main objectives were to measure the effectiveness of the overall system in altering the occupational composition of immigrants and to determine which specific policies had the most impact.

We had quarterly immigration data by occupation and country of origin. Standard time series analysis was used to examine (a) whether the occupational distribution changed when there was a shift in government policy, and (b) whether the occupational distribution changed in the “preferred” direction, that is toward greater skill. Clear policy breaks took place in 1960, 1967, 1974, 1982 and 1986.

In 1960 and 1967 we observed significant although mixed effects, as the less skilled workers series showed a downward shift, and the skilled workers series shifted upward. Both changes were significant at the 5% level. It is worth recalling that the point system was designed to set points commensurate with domestic labour force needs whether those needs were for skilled or unskilled workers. But in the 1970s and 1980s the observed shifts in immigrant flows in response to policy changes were less significant overall and where significant they were small.

Finally, we re-estimated these equations, but this time we allowed for changes in the share of family and refugee classes and for the proportion coming from Europe and the United States as opposed to the Rest of the World (ROW). We found that an increase in Family and Refugee Classes was associated with a decline in the flow of professionals and managers. An increase in the share of arrivals from ROW countries also resulted in a decline in the inflow of skilled workers. We concluded that changes in both source country and entrant class played a role in defining the occupational character of immigrants. A shift towards non-traditional countries and to Family class

* The following is a precis of an article which appeared in the *Canadian Journal of Economics* 27 (November, 1995), pp. 1006-1041.

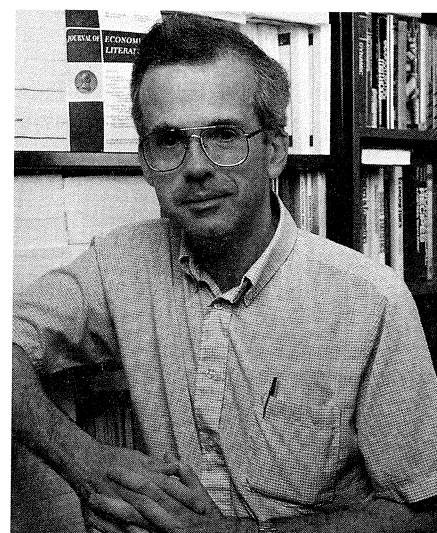
entrants tended to reduce the skill level.

Our finding that the point system was undermined by changing processing priorities across entry classes is confirmed by the 1968 immigration estimates. In that year the share of managers and professional workers entering as IPAS was over 40 percent of total arrivals while for the Nominated (Family) Class the share was about 6 percent. The important point is that a large portion of those arriving under the Nominated Class category were the least skilled.

Overall, then, the introduction of the point system in 1967 had a direct, and large, impact in increasing the skill level of immigrants. But in later years the effect of changes in assigned points was swamped by increases in the share of non-assessed classes and a shift in source countries. Elevating IPAS from the status of residual, to which they had fallen over the last two decades, is thus a necessary precursor to having the point system play a bigger role.

Alan G. Green (Queen's)
David A. Green (UBC)

*James G. MacKinnon, Sir Edward Peacock Professor of Econometrics (BA, York; MA and PhD, Princeton), has been a member of the Department since 1975. A Fellow of the Econometric Society and the Royal Society of Canada, Professor MacKinnon is one of the world's leading econometricians. Much of his work has been with Russell Davidson. Their text, **Estimation and Inference in Econometrics**, has become a standard especially in the area of hypothesis testing. Here James reports on a class of method that he and Russell have developed, which exploits the dramatically increased speed of modern computers.*



QED: You had a somewhat unusual undergraduate education, attending a bilingual college, Glendon, which is part of York University. Why did you choose a bilingual education?

JM: It was the 1960's, people were idealistic in those days, and it seemed an exciting place to go. It was concerned with public service in Canada and, of course, bilingual because of that. There was a strong orientation towards social sciences, history and also humanities, but not at all the sciences or mathematics. In fact there wasn't even a mathematics department.

QED: Did you at one point, then, perhaps see yourself going into public service?

JM: Yes, I think I probably did at one point, but I changed my mind.

QED: Your graduate studies were at Princeton, and surprisingly your work there wasn't in econometrics.

JM: Not most of it, one chapter was on applied econo-

metrics. Mostly it was on computing equilibria. There were a number of people working in this area at the time. Herb Scarf from Yale had recently published a book on the subject and my supervisor, Harold Kuhn, had done some work on it. They were different from conventional methods of solving systems of equations and rather exciting at the time.

QED: So when you first came on board at Queen's you were not hired to teach econometrics.

JM: No. I didn't teach any econometrics at all in my first two years.

QED: But then you got interested in it?

JM: I had taken it as a field and there was one chapter of my thesis and another paper, which I'd done as a graduate student, that were basically applied econometrics, estimating demand systems. But, I definitely got more interested in econometrics after I got here and started doing more work in the area.

QED: You have had a long professional collaboration with Russell Davidson. Is it true that he was not hired as an econometrician either? How did that collaboration come about?

JM: That's correct. He wasn't, and moreover I don't think he even specialized in it in graduate school. Russell came from being a physicist and did an Economics Ph.D. in three years from a standing start. He came to Queen's in 1977, two years after I got here, as an economic theorist, basically. Then in 1978 or 1979 I taught an advanced econometrics course (950). I can hardly remember what I talked about, because I certainly didn't know very much. Russell decided to sit in on it, and it was soon obvious that Russell had a much better grasp of these things than the students did. So I started chatting to him about some research ideas that I had, which eventually lead to the J-test, which is probably still our best known paper.

QED: Would you describe yourselves as having complementary skills?

JM: Largely. There is some division of labor, but it varies from paper to paper. I tend to do most of the heavy duty computing, although Russell has very strong computing skills. He tends to do most of the serious proofs and heavy analytics. The ideas come from both of us.

QED: Did you find the writing of your text book an arduous process?

JM: It is certainly true that it took longer than we'd expected and there were times during the process when I felt a bit of despair about whether it would ever be finished; and if it were finished, whether anyone would actually buy it. But once it was finally done we both felt a sense of accomplishment and tried to forget the less pleasant periods. One reason it took so long was that we changed our word processing package, because if we hadn't we would have had to rely on the publisher doing the typesetting.

QED: Why were you so reluctant to let the publisher do the typesetting?

JM: Because we wanted it done right! And we also wanted to have control over what the book looked like. So we had to switch.

QED: Was your primary motivation for the book a dissatisfaction with existing texts or more a desire to write a text that emphasized your own perspectives?

JM: It was a combination of the two. I guess if there had been any book that we were really happy with, we probably wouldn't have been inclined to write it. But given that there wasn't – and, yes we did want to get our perspective into print. As it turns out, the book has been surprisingly successful.

QED: How many reprints is it at now?

JM: It's now on its 6th printing and a 7th is planned. One of the advantages of the internet is that each time we make corrections or someone writes, notifying us of an error, I immediately make the necessary changes and put them up on the QED web server.

QED: Onto present research, you've moved into work on bootstrapping, why?

JM: I've long been interested in testing, especially specification testing. One of the big problems with tests in econometrics is that so many are based on asymptotic theory, and asymptotic theory often isn't very reliable. I've actually had experience with Monte Carlo simulations. There are tests that reject enormous proportions of the time when they should be rejecting, say, 5% of the time. That's pretty worrying; you can't tell people to go out and use these tests when they are so unreliable. The bootstrap provides a relatively mechanical way of getting accurate tests, remarkably accurate in many cases.

QED: It seems that advances in computing have greatly facilitated this work. What other changes in econometrics have been brought about by these advances?

JM: I can think of many examples. Nonlinear estimation is now trivial, and simulation-based nonlinear estimation, which used to be inconceivable, is now fairly routine. Bootstrapping is also becoming routine for some applications. And Bayesian econometrics has been revolutionized by advanced computers, though that's not an area Queen's has much strength in.

QED: Let's conclude with your view on future directions of research. Do you want to venture a guess about what the important future areas may be, have some things been neglected?

JM: It's always extremely hard to predict that. If you knew what the next hot topic would be, you'd be doing it. I honestly don't want to make predictions.

QED: Thanks for sharing your thoughts with us.

JM: My pleasure.

Bootstrap Testing

The bootstrap is one of the most exciting developments in statistics in the last quarter of this century. During the past two years, Russell Davidson and I have written six papers on various aspects of bootstrap testing. I have devoted a significant fraction of my recent ECON 950 (Advanced Topics in Econometrics) courses to the bootstrap, and we have both introduced the basic ideas in other graduate econometrics courses. Partly as a result, several Queen's Ph.D. students are currently doing research that involves bootstrap testing or other applications of bootstrap methods. In this brief article, I will try to explain what bootstrap testing is and how it can be useful in applied econometric research.

The term **bootstrap** was coined by Bradley Efron, a statistician from Stanford, almost 20 years ago. It's taken form the old phrase "to pull oneself up by one's own bootstraps." The key idea is that the data themselves, instead of approximate results based on unrealistic assumptions, are used to make statistical inferences. This is done by generating artificial **bootstrap samples** that are supposed to resemble the real data. In the simplest type of bootstrap, the artificial samples are obtained by resampling the data. This means that all the observations are, metaphorically speaking, thrown into a hat and then randomly pulled out one at time, with replacement, to form the bootstrap samples. Thus each bootstrap sample will contain some of the original observations exactly once, some of them more than once, and some of them not at all.

The basic idea of bootstrap testing is very simple. Suppose we have computed a test statistic, say $\hat{\tau}$. As an example, think of $\hat{\tau}$ as being the Durbin-Watson statistic for serial correlation in a linear regression model. If $\hat{\tau}$ is a number that would rarely occur by chance if the null hypothesis being tested were true, namely that errors are serially uncorrelated, then we want to reject that hypothesis. On the other hand, if $\hat{\tau}$ is a number that is reasonably likely to occur by chance, then we do not want to reject the null. The problem is to decide whether $\hat{\tau}$ is sufficiently extreme that it is unlikely to have occurred by chance. The bootstrap provides a way to do this that often works better than standard methods. In the case of the DW statistic, standard tables do not even give precise critical values, whereas bootstrap testing encounters no such problem.

With conventional methods of statistical inference, we decide whether $\hat{\tau}$ is sufficiently unlikely by comparing it with some theoretical distribution. In many cases, the (in practice, unknown) distribution that τ actually

follows is quite close to the theoretical one, and this procedure works perfectly well. In many other cases, however, especially when the sample size is not particularly large, the distribution that τ actually follows may be far from the theoretical one. As a consequence, conventional tests may reject the null hypothesis far more often (or, less commonly, far less often) than they are supposed to. One test for linear regression models has been observed to reject the null more than 99% of the time when it is supposed to reject it 5% of the time.

For a bootstrap test, we do not use any theoretical distribution. Instead, we generate a large number of bootstrap samples from a data-generating process that satisfies the null hypothesis and yields bootstrap samples that resemble the real one. There are often several reasonable ways to generate the bootstrap samples, and the choice among these may well affect how well the bootstrap tests perform.

There has been a good deal of theoretical work, mainly in the statistics literature, on the properties of bootstrap tests. One key result is that bootstrap tests give precisely the right answer whenever the test statistic τ is **pivotal**. This just means that the distribution of τ does not depend on any unknown parameters. In econometrics, many test statistics associated with linear regression models that have normal errors are pivotal, provided the regressors do not include lagged dependent variables. These include the Durbin-Watson statistic. Therefore, if the null hypothesis is true, bootstrap tests will reject it precisely as often as they are supposed to.

The way in which the bootstrap samples are constructed necessarily varies from case to case. Consider the linear regression model:

$$y_i^* = \beta_1 + \beta_2 x_i + \beta_3 y_{i-1} + u_i,$$

where the error terms are assumed to be normally and independently distributed (NID) with variance σ^2 , and we wish to test the null hypothesis that $\beta_3 = 0$. To bootstrap this model, we first estimate it by ordinary least squares under the null, so as to obtain estimates $\hat{\beta}_1$, $\hat{\beta}_2$, and s (the estimated standard deviation of the error terms). We then generate B bootstrap samples from the data-generating process

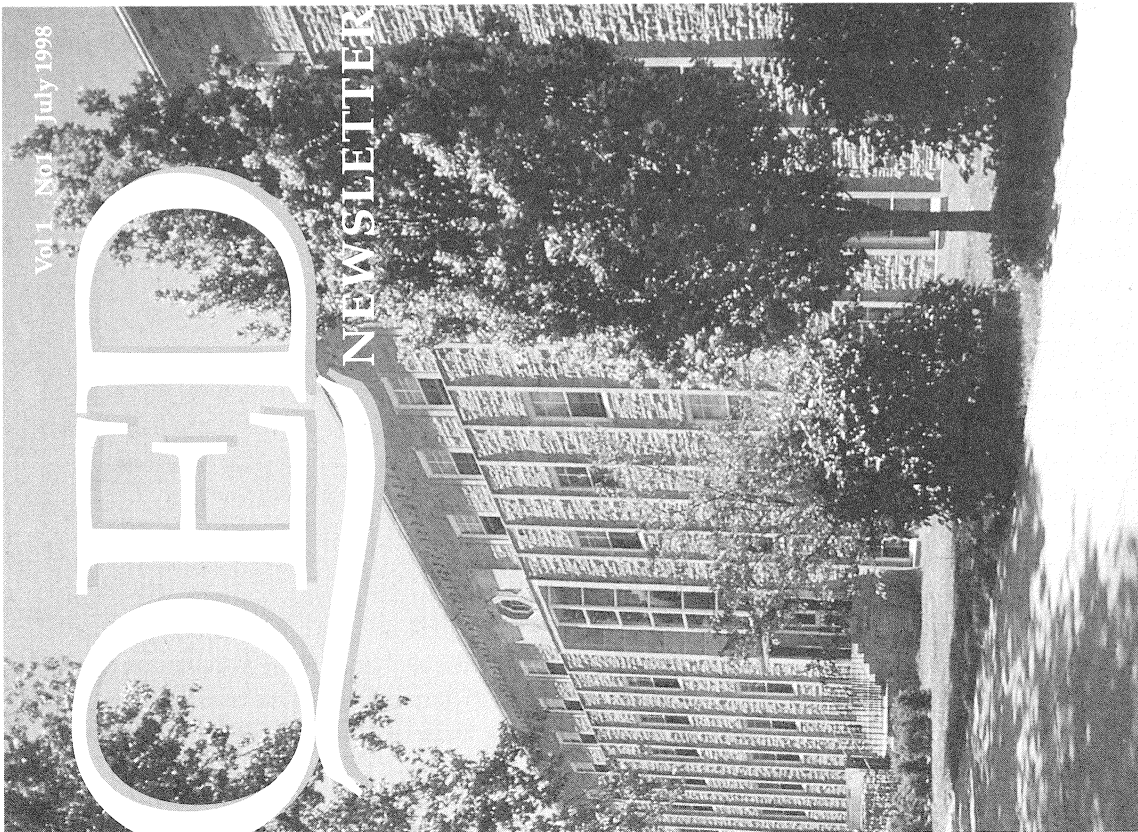
$$y_i^* = \hat{\beta}_1 + \hat{\beta}_2 x_i + u_i^*, \quad u_i^* \sim \text{NID}(0, s^2).$$

Thus each bootstrap sample uses a different set of error terms drawn from the normal distribution with mean 0 and variance s^2 . Notice that the bootstrap samples all

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satisfy the null hypothesis that $\beta_3 = 0$. This is an essential feature of bootstrap testing.

Modern computers are so fast that bootstrap testing in linear regression models is not computationally burdensome at all, and it is perfectly feasible for many nonlinear models as well. In the many cases for which bootstrap testing is easy to perform and works well, it is hard to justify a continued reliance on conventional tests that are often notoriously unreliable.

James G. MacKinnon

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In future issues of QED we plan to include a section on our graduates. So please drop us a line.

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