THE MISSING TABLET: COMMENT ON PETER KENNEDY'S TEN COMMANDMENTS

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1. Moses

In order to appreciate Peter Kennedy's (2002) paper containing the ten commandments of applied econometrics, let us briefly consider the historical background.

In Exodus, the second book of the bible, we read that Moses goes up and down Mount Sinai three times where God talks to him (19: 1–25). Then, after making himself spectacularly frightening, God gives the people of Israel the Ten Commandments (20: 1–17):

> (1) don't have other gods; (2) don't make a carved image; (3) don't take the name of the Lord in vain; (4) do honor the sabbath; (5) do honor your parents; (6) don't kill; (7) don't commit adultery; (8) don't steal; (9) don't give false testimony; (10) don't desire your neighbor's house (nor his wife, his male servant, his female servant, his ox, his donkey, or anything else that belongs to him, in that order).

Apparently, this famous speech is directed to the people of Israel, not to Moses privately. A much longer list of instructions is then given to Moses alone (20 : 22–23 : 33). Next, God orders Moses back up the mountain, where he stays for forty days and forty nights, receiving further instructions (25:1–31:17) and the two tablets of stone, 'written with the finger of God' (31:18). Coming down the mountain, Moses finds that the people have sunk to idolatry, sees the golden calf, and becomes extremely angry. He breaks the stone tablets to pieces, burns the calf, grinds it to powder, pours it out on the water, and makes the Israelites drink it. Thousands die. The next day, when Moses begs God to forgive the people, God refuses and, instead, strikes the nation with a plague (32:35). Eventually, God gives the law again, but this time to Moses privately and the people of Israel are not called on to submit to it (34: 1–35).

The first question is: why *two* tablets of stone? Surely, God could have written it all on one tablet, especially since the tablets were written on both sides (32:15).

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Personally, I like the following explanation, which offends so many people that it must be politically correct:

> After having written the commandments, God wonders what to do with them. He first turns to the British, who look at the commandments and say: 'Ah, we are not allowed to lie? This is not for us'. Next, he turns to the Germans, who say: 'Ach, no killing? Sorry, but no'. Then, he tries the French: 'Oh, we can't sleep with other women?' Finally, God turns to the people of Israel, who ask: 'What does it cost?' 'Nothing', says God. 'Then, give us two!'

Given the fact that Kennedy has produced a single paper, we should consider his work only half-done and we await the sequel. I have some recommendations for this sequel in my concluding comments.

In his new-found role as the Moses of Econometrics, Peter Kennedy realizes — with most historians and bible commentators — that originally there must have been two stories, and that the text in Exodus contains duplications (for example, Chapters 25–31 and 35–40 contain passages that are almost identical). Thus, Kennedy's story too is told twice: Sections 2 and 3 are slightly different expressions of the same ideas.

Kennedy's story, however, is more positive than Moses'. While the Ten Commandments contain eight 'don'ts' and two 'do's' (honor the sabbath and honor your parents), with Kennedy it is just the other way around. Only rule 5 (at least in the wording of Kennedy's Section 3) and rule 9 are negative, the others are positive.

I am sure that Moses did not foresee the worldwide impact of the Ten Commandments, but Kennedy has high hopes for his version. He expects that econometric instructors 'will incorporate them [the rules] into applied econometrics courses', and that textbook authors 'will add them to new editions'.

2. Tacit knowledge

It is hard not to agree with almost all the points that Kennedy makes. A glance at any recent applied econometrics article shows that it is good that these points continue to be made. It seems to me that the 'unwritten rules' that create 'a code of honor' are in fact part of what is called *tacit knowledge*. This is the sort of thing one learns by looking over some expert's shoulder (typically the Ph.D. supervisor), and is not written down in textbooks. The reason why these 'rules' are not written down in textbooks is that it is very difficult and also somewhat dangerous to do so. Typically such useful rules are not theorems — they are only true most of the time. For example, if a statement about square matrices (say of order n) holds for $n = 2$, then it does not necessarily hold for all n. But if it holds for $n = 3$, then it does hold for all n. This is useful, but there must be exceptions (I can't think of one), and therefore not universally true. Thus, if one has a choice between usefulness and truth, go for usefulness.

We should all encourage textbook writers to include tacit knowledge in their books. The same applies to authors of applied papers. Why not demand that each

applied paper contains a 'logbook' where the author tells us about the *path* that he or she has traveled before ending up at the reported spot. Such a logbook would be of interest in every discipline, but is surely indispensable in applied econom(etr)ics, where the bias and reliability of the results actually depend on the path. Such a logbook section can be short: 'I tried this, but it did not work, then I tried that but I got *t*-values which I did not like', and so on. But it would be revealing and add to the stature of our discipline.

3. Data and data mining

Rules 3 and 4 relate to data. Kennedy quotes Moore (1990) who states that 'data are numbers with a context'. I would add: 'Data are not numbers at all'. Data are random variables. The data provided by the Central Bureau of Statistics or the United Nations are not just numbers. They have gone through the hands of an expert statistician who has used — implicitly or explicitly — a model to generate the published data from the raw and conflicting sources available. This model could easily be quite close to the model subsequently used by the econometrician, in which case the latter's conclusion would be highly suspect. A few years ago, a student from Moscow wanted to study income inequality in Russia. He obtained data from Gozkomstat and fitted a lognormal distribution. The fit was perfect (residuals were zero) and he was happy. I urged him to investigate further, and it turned out that the statistician in Gozkomstat only had three data points from which he had constructed the remaining data using the lognormal distribution. This (one would hope) is an extreme example, but an element of it is likely to be present in many studies. Hence one should not only know the context and inspect the data, but one should also understand how the data have been collected.

Unfortunately, data analysis has low prestige in our profession. The late Zvi Griliches used to tell the story about a biologist studying thousand-year-old skulls from Africa based on measurements of local archeologists. After completing his paper, it turns out that the measurements are in error. In biology one would blame the biologist because he is taken to be responsible for making sure the data are good. But in economics we would blame the data collector and not the scientist. This seems wrong.

I strongly agree with Hoover's (1995) statement that data mining is not a sin. After all, how can we avoid it? It is a sin, however, to ignore the *effects* of data mining.

4. Statistical significance

We all agree that statistical significance is not the same as importance. However, this is not an easy issue. In sports one often hears that points are dependent. This is called the 'hot hand' in basketball and 'streaks' in baseball. I recently investigated whether there exists such dependence in tennis (Klaassen and Magnus, 2001). In contrast with other studies we had a large data set, almost 100 000 points. Almost all other studies could not reject the null hypothesis of no

dependence and typically concluded that, although very likely there was dependence, their data set was not large enough to detect it. We, on the other hand, did detect dependence, small but significant (and important in certain directions). As expected, the journal referees pointed out that with such a large data set anything would be significant. With the comments of basketball and baseball authors in mind I was tempted to ask the referees what the 'right' number of observations would be: 100, 1000, 10 000? But my co-author suggested that the referees might not be amused.

5. Sensitivity versus diagnostic testing

Again, I agree very strongly with the need for sensitivity analysis. I believe that one should not ask: is it true (diagnostic testing), but: does it matter (sensitivity analysis). The simplest example is the celebrated *t*-statistic. The *t*-statistic is used for *two* purposes, not one. Sometimes one wants to test whether a coefficient is zero or not. Then the *t*-statistic is appropriate (with the usual caveats). More often, however, one wants to know whether or not to include a particular regressor. Then, the question whether the corresponding coefficient is zero or not (based on the *t*-statistic) is not the right question. We are not interested in whether the coefficient is zero or not, very likely it is not. We are interested whether including the regressor makes our estimate or forecast (or whatever our focus variable is) better. *This is a completely different question*.

6. The missing tablet

I congratulate Peter Kennedy with a thought-provoking and very useful analysis, which will serve the profession well. The profession would be better off if Kennedy's commandments were followed. I was also enormously gratified and honored in finding myself described as an applied econometrician.

Unfortunately, as mentioned above, Kennedy's work is only half-done: there are two tablets but only one paper. I hope that Peter Kennedy will complete his task and write the sequel. The following four rules summarize my comments and may serve as a starting point for such a second paper.

11: If one has a choice between usefulness and truth, go for usefulness.
12: Every applied paper should contain a logbook section.
13: Data problems are the responsibility of the investigator, and should not be blamed on the data collector.
14: Don't try to amuse the referees.

One question remains. Are Kennedy's laws the first version or the second? Recall that in the Bible the Ten Commandments were first given to the people of Israel, not to Moses privately, while the second version was given to Moses privately and the people of Israel were not called on to submit to it. It follows that if Kennedy's laws are the first version we have to submit to them, but if they are the second, we don't.

References

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The Ten Commandments of Applied Econometrics. Article. Feb 2002. J Econ Surv. Peter E. Kennedy. Unpleasant realities of real-world data force applied econometricians to violate the prescriptions of econometric theory as taught by our textbooks. Leamer (1978) vividly describes this behavior as wanton sinning in the basement, with sinners' metamorphizing into high priests as they ascend to the third floor to teach econometric theory. But this sinning is not completely wanton--applied econometricians do (or should) follow some unwritten rules of behavior, in effect bounding the sinning and p