...NTIFYING LONG RUN AGRICULTURAL RISKS AND EVALUATING FARMER RESPONSES TO RISK

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New Procedures in Modelling Risk:

Discussion

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New Procedures in Modelling Risk: Discussion

I was tempted to subtitle this paper *De Gustibus Non Est Disputandum*, but then I remembered that Chalfant and Alston accounted for changes in tastes in 1988. The tastes that I had in mind are the revealed preferences for analyzing asymmetry or correlation when studying risky agricultural production. There are many studies that employ one or the other of these deviations from univariate normality. The Moss and Boggess paper is an admirable attempt to address both of these issues. The paper successfully demonstrates the difficulty of moving to higher indifference curves where both issues are addressed more satisfactorily.

In order to discuss the general issues raised in the paper I would like to focus on two sets of issues. First, the trade-off between modelling asymmetry and correlation that I have already referred to. And second, the distinction between estimation and simulation of multivariate distributions.

Asymmetry and Correlation

The authors claim that it is necessary to develop procedures that simultaneously allow treatment of asymmetry and correlation. (They refer to nonnormality instead of asymmetry. But I would argue that asymmetry is the real issue because any elliptically symmetric multivariate distribution has the same properties as the normal distribution which allow characterization of risk preferences in terms of mean and variance.) The first general question I wish to raise is "How necessary is it?" In other words, what's wrong with studies that focus on univariate asymmetry, or studies that focus on correlation under the maintained hypothesis of multivariate symmetry.

Consider, first, studies that focus on correlation. The generic study of this type is expected value - variance analysis of optimal portfolio choice. The utility (in terms of the researcher's utility or loss function) of including correlation, and risk aversion, is the value of the ability to explain diversification and identify optimal diversification. In my opinion, and, I think, in the opinion of the profession, this ability is very valuable. The demand for inclusion of asymmetry depends upon the utility of inclusion (or the loss from failure to include asymmetry). The paper doesn't really provide any insight into this utility.

One example of the utility of included asymmetry that I could easily find is the Collender and Chalfant study using the empirical moment generating function. They found, as had Collender and Zilberman before them, that the assumption of normality led to undervaluation of land in cotton and suboptimal levels of utility at certain levels of risk aversion. These conclusions are drawn under the maintained hypothesis of a constant absolute risk aversion utility function. Whether or not this is a significant deviation is a decision made according to each researcher's utility function. In my opinion it is not significant because it depends on the value of a risk aversion parameter that is unknown, or known with great uncertainty at best, as well as depending on the constant absolute risk aversion assumption. Further dropping the constant absolute risk aversion assumption requires adoption of a different numerical technique, such as separable programming, which can have alot of approximation error. Thus, I am not convinced that the introduction of multivariate asymmetry will lead to significantly better decisions about optimal diversification. And consequently, I do not see the need to use distributions that allow for asymmetry when diversification is a significant issue.

Studies that concentrate on univariate asymmetry have a shorter history than studies that involve correlation and diversification. Perhaps this is because there is less value in analyzing univariate asymmetry. The studies that I am familiar with in this area introduce asymmetry because statistical evidence has shown some crop distributions to be asymmetric, and because the assumption of symmetry can lead to significantly different conclusions. For example, the assumption of symmetry can cause crop insurance premiums to be inflated if the true distribution is negatively skewed.

When assessing whether or not correlation should be added to these studies we again face the question of what utility would be gained. In the case of examining crop insurance premiums I am confident that very little would be gained because premiums are determined on a crop by crop basis, and interaction between crops does not play a role. In other cases I am less sure, but I think it is fair to say that the burden of proof lies with those who argue that correlation needs to be included.

Estimation and Simulation

I find myself wondering whether the authors of this paper are proposing their multivariate distributions for purposes of estimating distributions from data, or simulating crop yields. I think they are more concerned with estimation of these distributions, so let me dispense with simulation quickly.

If parameters defining the location and scale, namely the mean vector and variance-covariance matrix, of a multivariate distribution are known, then there are a variety of procedures that can be used to simulate data from an asymmetric multivariate distribution. The family of multivariate Burr distributions is a rich family that captures many types of asymmetry that might be present in agricultural data. And they have flexible skewness, unlike the inverse Gaussian distribution. Further, details about such simulation are easily attainable in books, such as Johnson's Multivariate Statistical Simulation(Wiley:1988).

Now consider the much more difficult issue of estimation with multivariate data. I will ignore the issue of detrending data because I think that for most practical purposes it is adequate to transform the data to stationarity, and carry out estimation procedures with the stationary data.

The paper presents two procedures for estimating multivariate crop distributions. First, consider the transformation to normality approach. A trivariate distribution is fit for Holmes, Okaloosa, and Walton county corn yields. Maximum likelihood estimates are presented with asymptotic standard errors. This is a case where the appeal to large sample properties of estimators seems dubious to me. The data set contains 28 observations which are used to estimate 16 parameters. In these circumstances, small sample properties seem to be a much more appropriate way to evaluate the estimates. Monte Carlo analysis of simultaneous equation estimators has shown that there can be significant differences between large and small sample properties of multivariate estimates. The problem is that the statistical theory of small sample properties is very complicated and poorly developed. Almost all of the statistical theory of multivariate analysis is developed for samples from multivariate normal distributions, with robustness studies performed for other elliptical distributions.

Muirhead explains that there are two main reasons why the multivariate distribution is the building block of multivariate analysis. "First, it is often the case that multivariate distributions are, at least approximately, normal distributions.... Secondly, the multivariate normal distribution and the sampling distributions it gives rise to are, in the main, tractable."

Small sample properties are likely to be relevant for most estimation problems involving multivariate agricultural data because the annual nature of agricultural production limits the number of observations. Estimation of the mean and covariance matrix of the joint density of six crops requires the estimation of twenty seven parameters, which is more than the number of observations in many data sets. Thus it is frequently necessary to make simplifying assumptions about the structure of the covariance matrix in order to generate enough degrees of freedom to perform reasonable estimation.

An extreme simplifying assumption, independence, allows the estimation of univariate distribution functions. Typically, the properties of estimates from univariate distribution functions are better understood than those from multivariate distribution functions. And the independence assumption allows the degrees of freedom provided by the full sample to be used to estimate each of the marginal distributions. Thus it should be possible to obtain much more accurate estimates under the independence assumption than can be obtained by estimating the full joint density function. Under such circumstances it is likely that the objectives of the research and the utility function of the researcher produce a preference for estimating marginal distributions. It seems to me that the authors should provide some explanation of the circumstances under which imprecise estimation of the joint density function would be preferred.

The second estimation procedure that is proposed is estimation of univariate and multivariate inverse Gaussian distributions. Estimation of the multivariate Gaussian distribution is going to be subject to the same problems discussed above - primarily, what are the small sample properties. But this approach creates the additional problem of imposing positive skewness on the data. This assumption seems much too strong for a procedure intended to be applied to general agricultural data. There is evidence that negative skewness is likely to be found in a significant number of crop yield distributions.

Conclusions

The common theme in all of my comments is that the value of the procedures presented in this paper depends upon the use they are put to. Ultimately, procedures for modelling the riskiness of agricultural production should be put to the use of explaining behavior. As I look at the types of behavior that have been explained I have doubts that the procedures proposed in the Moss and Boggess paper can provide any new insights. But I am sure that there is alot about behavior under risk that hasn't been explained. Maybe the proposed procedures can provide insight into such behavior. If the authors could produce such insight then they could claim to have truly found something new under the sun.

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