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# Seminar

**LIMITING FORMS OF THE  
MULTIVARIATE EXTENDED  
SKEW-NORMAL AND SKEW-STUDENT  
DISTRIBUTIONS, MARKET CRASHES  
AND THE CAPITAL ASSET PRICING  
MODEL**

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**Abstract :** [www.stat.unipd.it/fare-ricerca/seminari](http://www.stat.unipd.it/fare-ricerca/seminari)

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# LIMITING FORMS OF THE MULTIVARIATE EXTENDED SKEW-NORMAL AND SKEW-STUDENT DISTRIBUTIONS, MARKET CRASHES AND THE CAPITAL ASSET PRICING MODEL

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This paper is concerned with the location parameter, often denoted  $T$ , of the truncated normal and Student  $t$  distributions, both of which play a role in the derivation of the multivariate skew-normal [MESN] and skew-Student [MEST] distributions. The paper is motivated, first, by empirical evidence reported in the financial economics literature that  $T$  assumes values that are less than zero and, secondly, by stock market crashes, in which  $T$  is both negative and of large magnitude. The paper presents limiting forms of the MESN and MEST distributions.

These results are used to examine the properties of stock market crashes, regarding which there is a widely held popular belief that "*all correlations go to one in a crisis*". This paper investigates the changes in correlation that occur when the conditional distribution of asset returns given a market crash is used. Assuming an underlying multivariate normal distribution for asset returns, under the conditioning: (i) returns have a skewed distribution when there is a crash, but the conditioning variable is the sole source of skewness; (ii) betas remain unchanged; (iii) unit correlations will arise if residual risks vanish and asset returns are determined only by the return on the market portfolio or; (iv) by arcane changes to the parameters of the underlying distribution. Interestingly under normality, whether or not there are changes in the underlying parameters, the market return becomes deterministic as the crash magnitude increases without limit. If returns follow a multivariate Student distribution, results (i) to (iv) hold essentially unchanged. In sharp contrast, the market return distribution has a standard deviation that increases with the magnitude of the crash. The paper also considers linear factor models of the Fama and French type. Under both normal and Student distributions unit correlations will only arise if the factors themselves are perfectly correlated. Under both the distributions considered in this paper, unit correlations require complex changes to model parameters, which offers some support for the mixed findings reported in the literature about correlations at times of market crashes.