

## COMFORT-CCClass: A Common Market Factor Non-Gaussian Returns Model

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A new multivariate returns model with various attractive properties is motivated and studied. By extending the CCC model in several ways, it allows for all the primary stylized facts of asset returns, including volatility clustering, non-normality of asset returns (excess kurtosis and asymmetry), and also dynamics in the dependency between assets over time. A fast EM-algorithm is developed for estimation. The predictive conditional distribution is a (possibly special case of a) multivariate generalized hyperbolic, so that sums of marginals (as required for portfolios) are tractable. Each marginal is endowed with a common univariate shock, interpretable as a common market factor, and this stochastic process has a predictable component. This leads to the new model being a hybrid of GARCH and stochastic volatility, but without the estimation problems associated with the latter, and being applicable in the multivariate setting for potentially large numbers of assets. Formulae associated with portfolio optimization, risk measures and option pricing based on the predictive density are developed. In-sample fit and out-of-sample conditional density forecasting exercises using daily returns on the 30 DJIA stocks confirm the superiority of the model to numerous competing ones.

**Key Words:** CCC; Density Forecasting; EM-Algorithm; Fat Tails; GARCH; Multivariate Asymmetric Laplace Distribution; Multivariate Asymmetric  $t$  Distribution; Multivariate Generalized Hyperbolic Distribution; Multivariate Normal Inverse Gaussian Distribution; Stochastic Volatility.