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Working Paper

Estimating a bivariate density when there are extra data on one or both components

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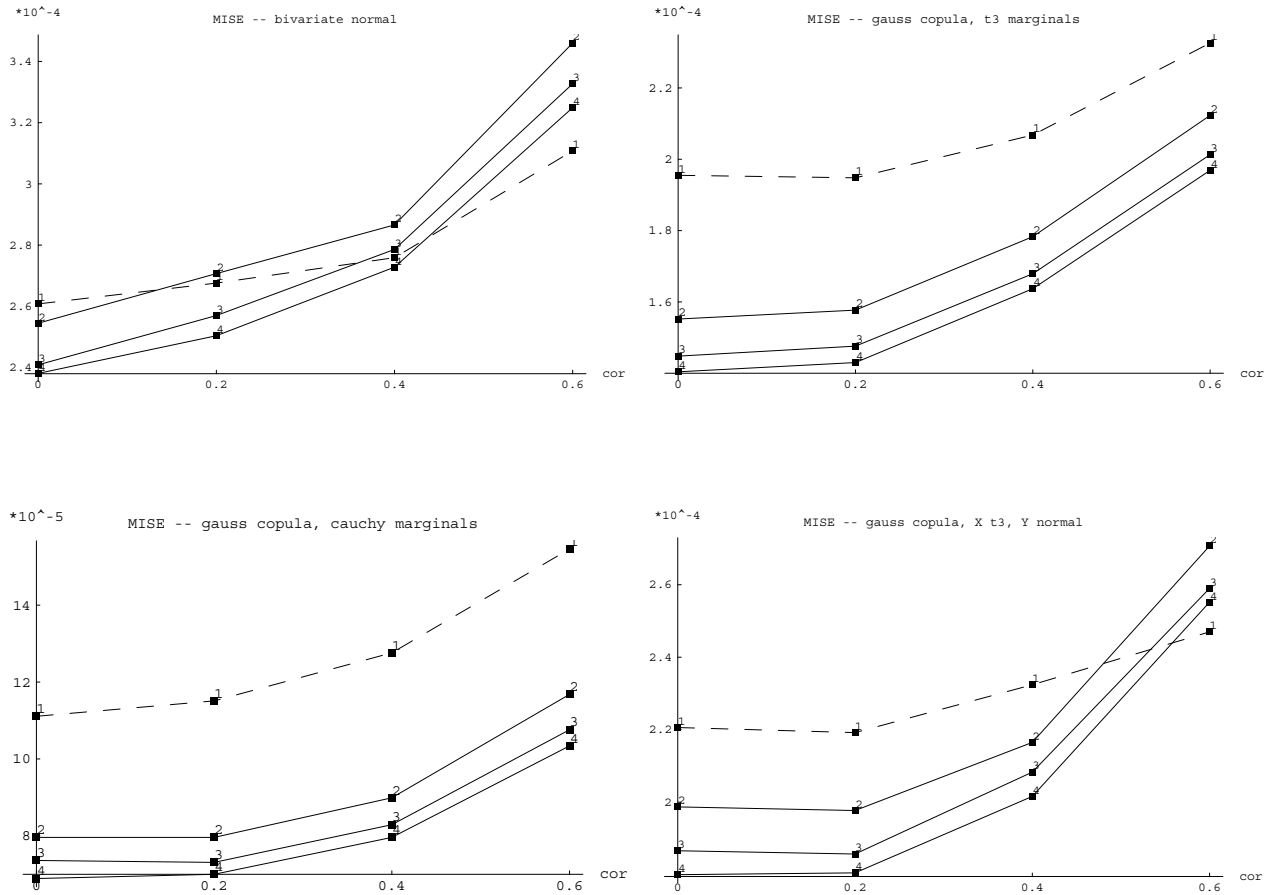


Figure 1: *MISE* as a function of ρ , in the case of the Gaussian copula. *MISE* and ρ are represented on the vertical and horizontal axes, respectively. In each panel the dashed curve, curve 1, corresponds to the bivariate kernel density estimator, and curves 2, 3 and 4 are for the copula based estimator with, respectively, $q = 20, 50$ and 100 extra observations in the Y sample. Throughout, $p = 0$ and $n = 20$. In the first row of panels, both marginals are standard normal in the left panel and both are t_3 in the right. In the second row, both marginals are Cauchy in the left panel; in the right panel, X is t_3 and Y standard normal.

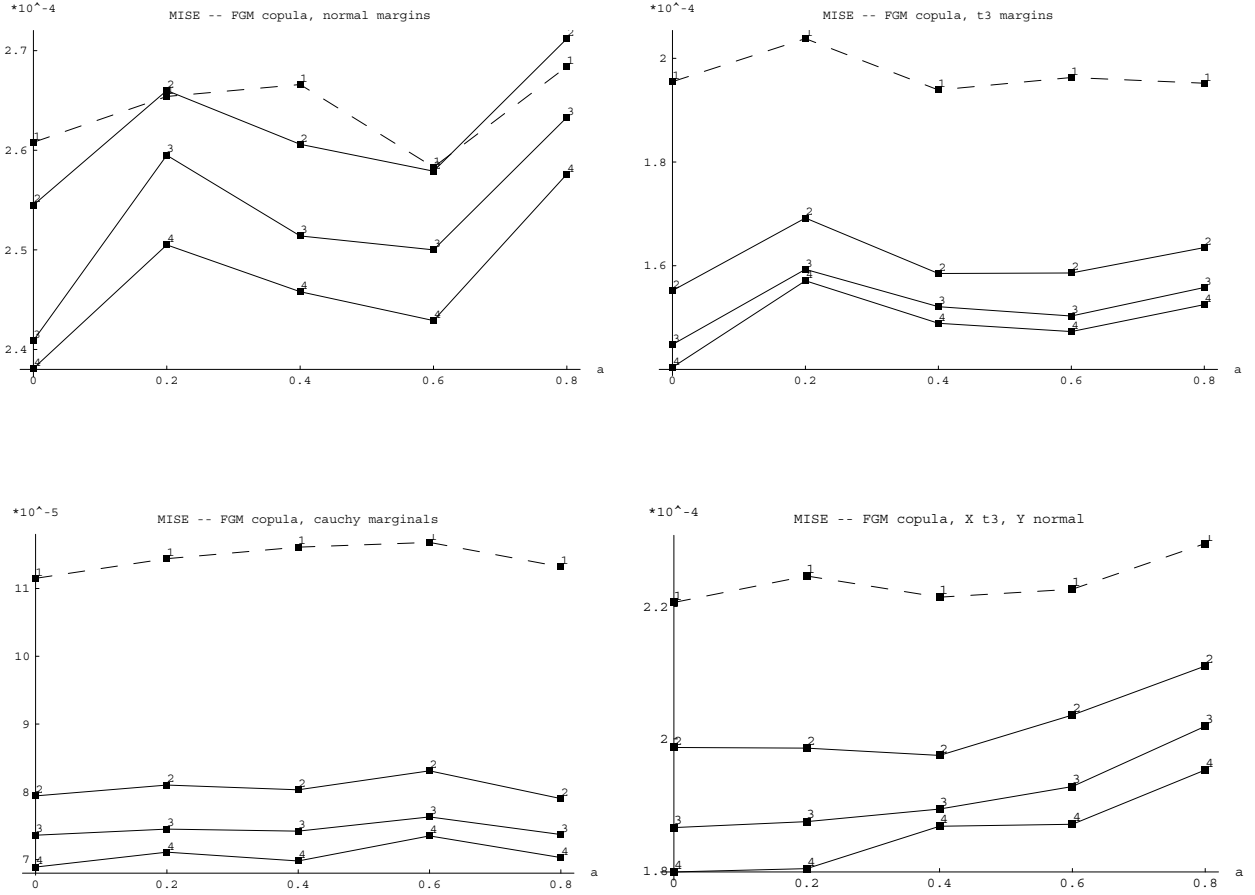


Figure 2: *MISE* as a function of a , in the case of the Farlie-Gumbel-Morgenstern copula. With the exception that a here replaces ϱ , all details are as for Figure 1.

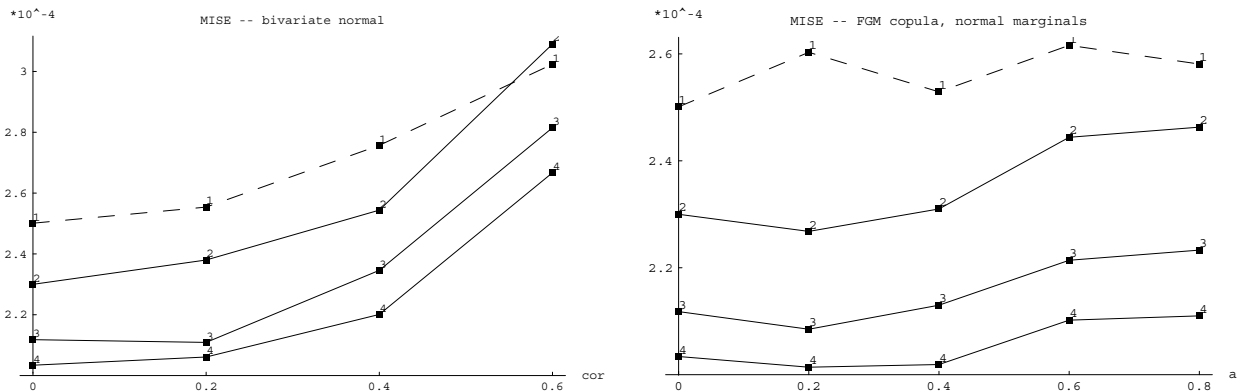


Figure 3: *MISE* as a function of ρ or a for different values of q , in the case of the Gaussian or Farlie-Gumbel-Morgenstern copula, in the left and right panels, respectively. With the exception of copula type, and the fact that $p = q$ for the present figure, all details are as for Figure 1.

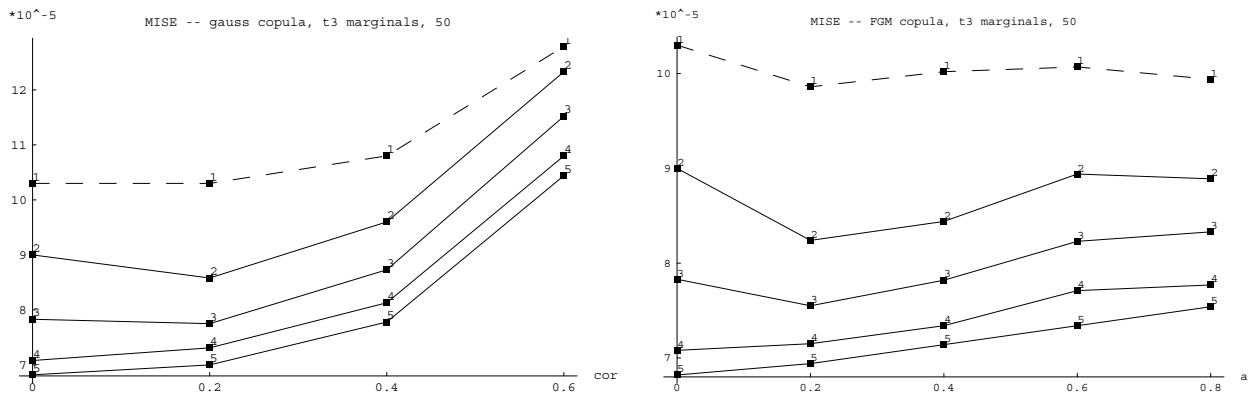


Figure 4: *MISE* as a function of ρ or a , in the case of the Gaussian or Farlie-Gumbel-Morgenstern copula, in the left and right panels, respectively. Curve 1 corresponds to the bivariate kernel density estimator, and curves 2, 3, 4 and 5 are for the copula based estimator with $p = q = 20, 50, 100$ and 150 extra observations in the both samples, respectively. Both marginal distributions are t_3 , and $n = 50$.

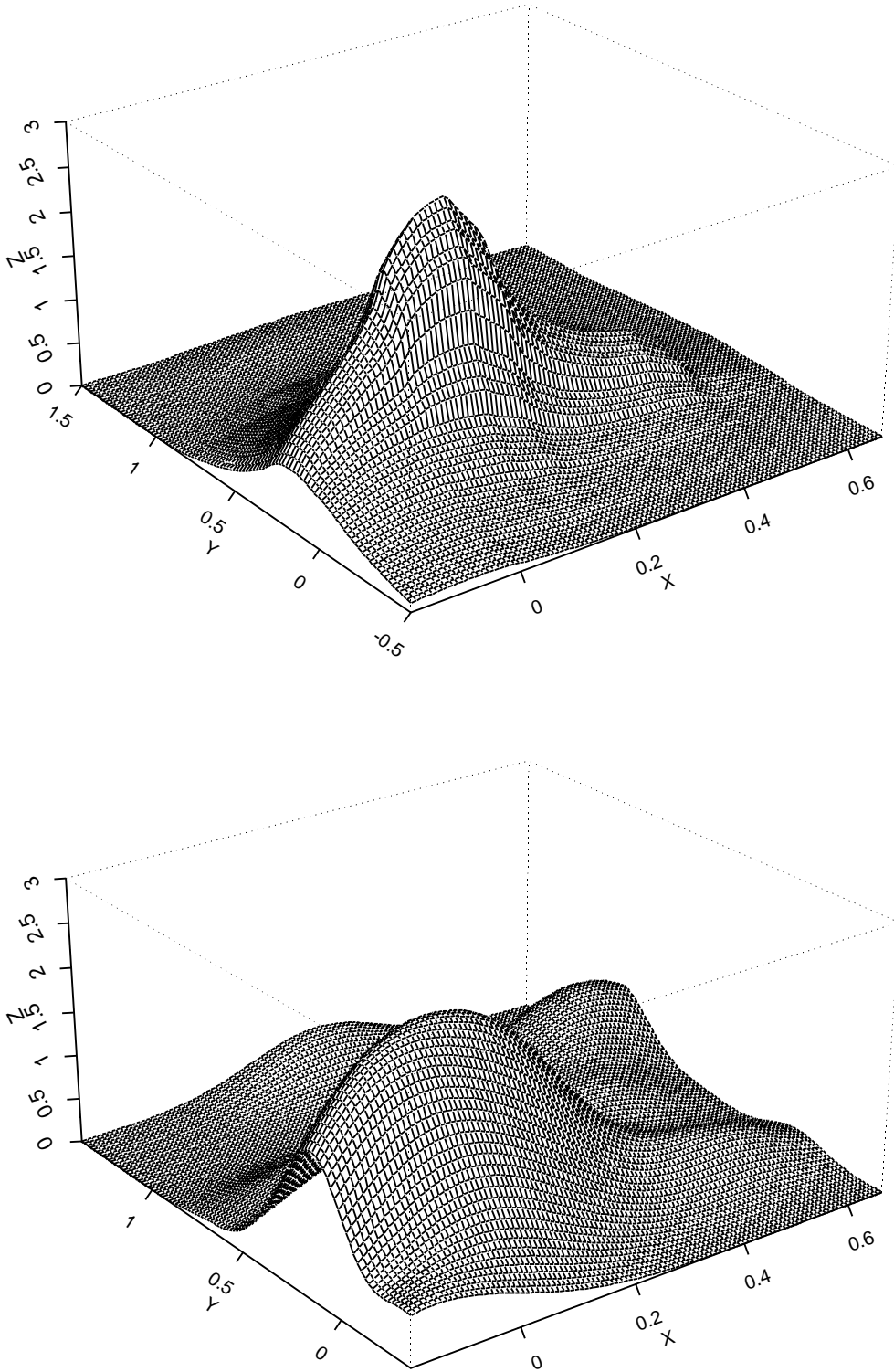


Figure 5: Copula based and kernel estimators, in the upper and lower panels respectively, for the real dataset.