## Elisabetta Alvoni, Pier Luigi Papini Quasi-concave copulas, asymmetry and transformations

Comment.Math.Univ.Carolin. 48,2 (2007) 311-319.

**Abstract:** In this paper we consider a class of copulas, called quasi-concave; we compare them with other classes of copulas and we study conditions implying symmetry for them.

Recently, a measure of asymmetry for copulas has been introduced and the maximum degree of asymmetry for them in this sense has been computed: see Nelsen R.B., Extremes of nonexchangeability, Statist. Papers 48 (2007), 329–336; Klement E.P., Mesiar R., How non-symmetric can a copula be?, Comment. Math. Univ. Carolin. 47 (2006), 141–148. Here we compute the maximum degree of asymmetry that quasi-concave copulas can have; we prove that the supremum of  $\{|C(x,y)-C(y,x)|; x, y \text{ in } [0,1]; C \text{ is quasi-concave} \}$  is  $\frac{1}{5}$ . Also, we show by suitable examples that such supremum is a maximum and we indicate copulas for which the maximum is achieved.

Moreover, we show that the class of quasi-concave copulas is preserved by simple transformations, often considered in the literature.

Keywords: copula, quasi-concave, asymmetry AMS Subject Classification: 62H05, 26B35