# Checking compatibility of discrete conditional distribution by graph-theoretic approach

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## Abstract

For two discrete random variables $X$ and $Y$ taking on values $x_1,\ldots,x_I$ and $y_1,\ldots,y_J$, respectively, a putative conditional model for the joint distribution of $X$ and $Y$ consists of two $I \times J$ matrices representing the conditional distributions of $X$ given by and of $Y$ given $X$. We say that two conditional distributions (matrices) $A$ and $B$ are compatible if there exists a joint distribution of $X$ and $Y$ whose two conditional distributions are exactly $A$ and $B$. We present new versions of necessary and sufficient conditions for compatibility of (finite) discrete conditional distributions via a graph-theoretic approach. Moreover, we show that there is a unique joint distribution for two given compatible conditional distributions if and only if the corresponding graph is connected.

Keywords: compatibility of conditional distributions, graph theory, connectedness