

# Double Roman domination number on cardinal product of graphs

Antoaneta Klobučar<sup>1</sup> and Ana Klobučar<sup>2</sup>

<sup>1</sup>Faculty of Economics, HR-31000 Osijek, Croatia, aneta@efos.hr

<sup>2</sup>Faculty of Mechanical Engineering and Naval Architecture, Zagreb, Croatia, aklobucar@fsb.hr

Roman domination was named after the way the Roman emperor Constantine (274-337 AD) distributed his legions to defend borders of the Empire against barbarian attacks. Some border areas had 1 or 2 legions, and some had no legions, but they had at least 1 neighbouring area with 2 legions.

Double Roman domination is a stronger version of Roman domination that doubles the protection by ensuring that any attack can be defended by at least two legions.

A function  $f : V \rightarrow \{0, 1, 2, 3\}$  is a *double Roman dominating function* (DRDF) on a graph  $G$  if it satisfies the following conditions. Let  $V_i$  denote the set of vertices assigned  $i$  by function  $f$ .

- (i) If  $f(v) = 0$ , then vertex  $v$  has at least two neighbors in  $V_2$  or one neighbor in  $V_3$ .
- (ii) If  $f(v) = 1$ , then vertex  $v$  has at least one neighbor in  $V_2 \cup V_3$ .

The *double Roman domination number*  $\gamma_{dR}(G)$  equals the minimum weight of a double Roman dominating function on  $G$ , and a double Roman dominating function of  $G$  with weight  $\gamma_{dR}(G)$  is called a  $\gamma_{dR}$ -*function* of  $G$ .

In this paper we determine some upper and lower bounds for double Roman domination numbers on cardinal product of any two graphs and some exact values for the cardinal product of paths and cycles.