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Analyzing Distance-Regular Graphs Arising From Primitive Groups

Using the GAP software system, we investigated distance-regular graphs on up to 4095 vertices that arise from primitive permutation groups. The graphs obtained were categorized based on the number of vertices they had; those that were a prime or prime power and those that were not. The various built-in commands in the GAP software allowed us to determine multiple properties of each graph. This included the group, rank, orbitals, and intersection array. This information helped identify graphs included in common families such as the Paley, Peisert, Hamming, Johnson, Kneser, and Grassmann graphs. During our research, we came across a graph that we concluded was unknown. This graph has 136 vertices, arises from the group $PSL(2,17)$ with rank 12, and has intersection array $\{63,32;1,28\}$, so is strongly regular with parameters $(136,63,30,28)$. The graph $NO_8^-(2)$ also has these parameters. We further investigated both the unknown graph and the graph $NO_8^-(2)$ (and their complements) to determine how similar they were in terms of the clique number, chromatic number, and independence number. We concluded that the unknown graph and $NO_8^-(2)$ have many different properties.