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A Note on Disjoint Covering Systems of Congruences: Variations on a 2002 AIME Problem.

A system of congruences $S = \{x \equiv a_i \pmod{m_i} : 1 \leq i \leq k\}$ is a set of k arithmetic progressions given by, $\{x = nm_i + a_i : 1 \leq i \leq k \text{ and } n \in \mathbb{Z}\}$. Erdős introduced the idea of such a system with the property that every integer belongs to at least one congruence in the system. In 1950, he used this type of system to solve a problem presented to him by Romanoff and called such a system a *covering system of congruences*. During an REU conducted at Youngstown State University this summer, the authors considered covering systems and some classical results about these arithmetic progressions. Two new results about covering systems were proven by the authors during this summer research. These results provide an upper bound on the number of consecutive integers which need to be checked to determine if a system is a special type of covering system. This bound is given only in terms of k , the number of congruences in the system. These results provide an analog of a theorem by R. B. Crittenden and C. L. Vanden Eynden from 1969 and are presented as solutions to some variations of a 2002 AIME Problem about painting a picket fence. (Received September 16, 2008)