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Additive triples in groups of odd prime order

Let p be an odd prime. For nontrivial proper subsets A, B of $\mathbb{Z}_p$ of size s, t, respectively, we count the number $r(A, B, B)$ of *additive triples*, namely elements of the form $(a, b, a+b)$ in $A \times B \times B$. For given s, t, what is the spectrum of possible values for $r(A, B, B)$?

In the special case $A = B$, the additive triple is called a *Schur triple*. It is known that the Cauchy-Davenport Theorem gives bounds on the number $r(A, A, A)$ of Schur triples, and that the lower and upper bound can each be attained by a set A that is an interval of s consecutive elements of $\mathbb{Z}_p$. However, it is known that there are values of p, s for which not every value from the lower bound to the upper bound is attainable.

In the case where A, B can be distinct, we use Pollard's generalization of the Cauchy-Davenport Theorem to derive bounds on the possible values of the number $r(A, B, B)$ of additive triples. In contrast to the case $A = B$, we show that every value from the lower bound to the upper bound is attainable; and it is sufficient to take B to be an interval of t consecutive elements of $\mathbb{Z}_p$.

This is joint work with Sophie Huczynska and Laura Johnson.