Abstract: We will discuss two types of problems in extremal combinatorics. First, we discuss problems about covering sets of points using affine hyperplanes. We consider a higher multiplicity generalization of a result of Alon and Füredi about the minimum number of hyperplanes needed to cover all but one vertex of an \( n \)-cube. We then discuss related covering problems for triangular grids.

Next, we answer a question in arithmetic Ramsey theory. For a fixed set \( D \), of positive integers, let \( \Delta(D, k; 2) \) be the smallest \( N \) such that any 2-coloring of \( \{1, 2, \cdots, N\} \) contains a monochromatic sequence \( a_1 < a_2 < \cdots < a_k \), whose consecutive differences, \( a_{i+1} - a_i \), are all elements of \( D \). We provide the first example of a set \( D \) where \( \Delta(D, k; 2) \) grows faster than any polynomial in \( k \).