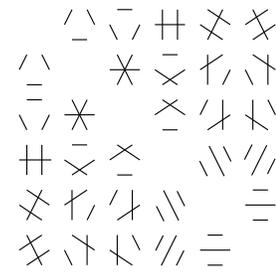


# Mathematics Seminar



## Rocky Mountain Algebraic Combinatorics Seminar

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### The inverse theorems of Schnirelmann, Mann, and Kneser

John Griesmer  
Colorado School of Mines

The lower asymptotic density of a set of natural numbers  $A$  is

$$\underline{d}(A) := \liminf_{n \rightarrow \infty} \frac{1}{n} |A \cap \{1, \dots, n\}|.$$

Given two sets of natural numbers  $A$  and  $B$ , their *sumset* is

$$A + B := \{a \in A, b \in B\}.$$

In 1953, Martin Kneser famously characterized the sets  $A, B \subseteq \mathbb{N}$  satisfying  $\underline{d}(A + B) < \underline{d}(A) + \underline{d}(B)$ . In this talk we will:

1. construct pairs  $A, B \subseteq \mathbb{N}$  satisfying  $\underline{d}(A + B) < \underline{d}(A) + \underline{d}(B)$ , and pairs satisfying  $\underline{d}(A + B) = \underline{d}(A) + \underline{d}(B)$ ;
2. survey Kneser's theorem and some of its analogues, in particular Renling Jin's version on upper Banach density.

### Generalizing Kneser's Theorem

John Griesmer  
Colorado School of Mines

We generalize Kneser's density theorem, replacing "lower asymptotic density" with other densities in the natural numbers. We further generalize to the setting of discrete abelian groups.

Weber 223  
4–6 pm, Friday, September 19, 2025  
(Refreshments 3:30–4 pm)  
Colorado State University  
4 pm, Friday, September 19, 2025

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This is a joint Denver U / CU Boulder / U of Wyoming / CSU seminar that meets biweekly.  
Anyone interested is welcome to join us at a local restaurant for dinner after the talks.



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