Mathematics Research Symposium
May 1, Thursday 1:10 pm – 3:15 pm
Research Mentor: Béla Bajnok
Symposium Emcee: Claire Zajaczkowski

1:15 pm – 1:25 pm
A brief introduction to additive combinatorics
Kevin Campbell, Kelly Collins, and Beth Matys
Students in Math 401 will explain concepts and results that are necessary for following the rest of the talks in this Symposium.

1:27 pm – 1:35 pm
What’s nu? Exploring when \( \nu_2(G, m, h) < \min\{n, c(h, m)\} \)
Mandy Buckell
We investigate when the value of \( \nu_2(G, m, 2) \), the maximum size of a 2-fold span of an m-element subset of G, is less than the upper bound of \( \min\{n, c(h, m)\} \). We use \( c(h, m) = \sum_{d|h} (\frac{\mu(d)}{d}) \cdot \nu_2(G, m, h) \). The cases where \( m = 2, 3, 4 \), and 5 are closely examined to find patterns among the sets that give us the value of \( \nu_2(G, m, h) \).

1:37 pm – 1:49 pm
Shopping For Nu Hats: A Lower Bound for \( \nu(Z_n, m, 2) \)
Alice Mitnick
In our research, we explored the maximum value of restricted sumssets with a fixed number of terms added. We represent this by \( \nu(Z_n, m, 2) \). This is to find the maximum size of a subset generated in a finite abelian group \( Z_n \). We took \( m \) as the size of the subset \( A \subset Z_n \) we use to generate sumsets. These are generated by adding two distinct terms of \( A \) to each other. Here, we find a formula for a lower bound of \( \nu(Z_n, m, 2) \).

1:51 pm – 1:59 pm
\( \phi, \Phi, \Phi, Phm: \) Investigating when \( m = 3 + 1 \)
Samantha Cross
A subset \( A \subset G \) is a signed h-spanning subset if \( h_A \) includes every element of G. We use \( h_A \) to denote every signed sum of \( n \) not necessarily distinct terms in \( A \). We are looking for the minimum value of one of these spanning subsets, denoted by

\[ \phi_1(G, h) = \frac{n}{m} \]

Specifically, we are investigating \( \phi_1(Z_n, h) = 4 \) and looking for which \( n \) and \( h \) values require a subset of size 4 to span the group.

2:01 pm – 2:09 pm
Hold Onto Your Hats! The Fun is not Sidon Yet!
Sam Edwards
Finding the maximum size of a Sidon set for a group \( Z_n \) has been a famous problem in additive combinatorics; my research added a spin to this classic problem by allowing subtraction. A Sidon set is a subset in which all \( h \)-termed signed sums of distinct elements are distinct. The notation \( \sigma(h)(G) \) is used to denote the maximum size of a Sidon set in a finite abelian group \( G \). Some preliminary findings, including upper bounds and “pretty sets”, will be discussed.

2:15 pm – 2:31 pm
Covering Everything: An Exploration of h-Critical Numbers
Kevin Campbell
Given an \( h \), \( m \), and a group \( Z_n \), \( \rho(Z_n, m, h) \) defines the smallest possible size of an \( h \)-fold subset of \( A \) where \( A \) is a subset of \( Z_n \) and \( A \) has size \( m \). An \( h \)-critical number is the minimum value of \( m \) such that \( \rho(Z_n, m, h) = n \). That is, if a subset \( A \) of a finite abelian group \( G \) is at least the size of the \( h \)-critical number of \( G \), then the \( h \)-fold subset of \( A \) will span \( G \). Thus far, I have created bounds for all \( h \)-critical numbers, several equations to find the \( h \)-critical number in several sub-sets of \( Z_n \), and I have a conjecture to cover all other cases.

2:33 pm – 2:49 pm
How to Get Sum Free Sets: An Inexpensive Ordeal with Hats, II
Kelly Collins
In this talk I will discuss my findings for \( \tau_2(G, h) \), defined as the maximum size of a subset, \( A \), in a group, \( G \), such that 0 is not produced within the restricted h-fold span. I will discuss the value and bounds of \( \tau_2(G, h) \) for h-values 1 and 2 for all groups, and for the h-values 3 and greater for cyclic groups.

2:51 pm – 3:07 pm
Tauer of Terror: Not as Scary as One Might Think
Elizabeth Matys
Given a subset \( A \) in a finite abelian group \( G \), and a positive integer \( h \), \( A \) is zero-h-sum-free if the signed sum of any \( h \) (not necessarily distinct) elements in \( A \) is never equal to zero. Working in \( Z_n \), we explore the maximum zero-h-sum-free set size over the set of all integers for odd \( h \). That is, the quantity defined as

\[ \tau_2(Z_n, h) = \max \{|A| \mid A \subset Z_n, 0 \not\in h_A \} \]

We establish the value of \( \tau_2(Z_n, h) \) for all even \( n \) and construct two lower bounds where \( n \) is odd. We also determine the value for some cases of prime \( n \).