

# Dylan C. Beck

4100 S 4th St. ◇ Leavenworth, KS 66048  
(###) ###-#### ◇ Dylan.Beck@StMary.edu

## EDUCATION

---

### University of Kansas

Ph.D, mathematics ..... May 2022

Ph.D advisor: Hailong Dao

Ph.D thesis: *Combinatorial and Homological Aspects of Monomial Algebras and Numerical Semigroups*

### Missouri State University

B.S. with Honors, mathematics (minor in German) ..... May 2016

GPA: 4.00/4.00; member of Kappa Mu Epsilon (Mathematics Honors Society)

## EMPLOYMENT

---

### University of Saint Mary

Assistant Professor of Mathematics ..... Aug 2024 to present

- |  |  |
|--|--|
| ◇ MA 135 (Quantitative Literacy: Math in the Real World) | ◇ MA 345 (Calculus III: Multivariable) |
|  | ◇ MA 463 (Abstract Algebra)            |

### Baker University

Visiting Assistant Professor of Mathematics ..... Aug 2022 to May 2024

- |  |  |
|--|--|
| ◇ MA090 (Intermediate Algebra)           | ◇ MA291 (Introduction to Higher Math)    |
| ◇ MA145 (College Algebra)                | ◇ MA345 (Problem Seminar in Mathematics) |
| ◇ MA146 (Trigonometry)                   | ◇ MA372 (Differential Equations)         |
| ◇ MA172 (Calculus II)                    | ◇ MA383 (Introduction to Modern Algebra) |
| ◇ MA221 (Statistics I)                   | ◇ MA445 (Senior Seminar in Mathematics)  |
| ◇ MA281 (Introduction to Linear Algebra) | ◇ MA491 (Introduction to Real Analysis)  |

### University of Kansas

Graduate Teaching Assistant in Mathematics ..... Aug 2016 to May 2022

Courses are marked with an asterisk (\*) to signify instructor of record.

- |  |                                  |
|--|----------------------------------|
| ◇ MATH 002 (Intermediate Algebra)            | ◇ MATH 115 (Applied Calculus I)* |
| ◇ MATH 101 (College Algebra)                 | ◇ MATH 125 (Calculus I)          |
| ◇ MATH 104 (Precalculus)*                    | ◇ MATH 126 (Calculus II)         |
| ◇ MATH 105 (Intro to Topics in Mathematics)* | ◇ MATH 127 (Calculus III)        |

Organizer, Graduate Student Algebra Seminar ..... Aug 2021 to May 2022

Leader, Algebra Ph.D Qualifying Exam Study Group ..... Aug 2018 to May 2022

Leader, Probability and Statistics Ph.D Qualifying Exam Study Group ..... Aug to Dec 2018

Undergraduate Supervisor, Kansas Algebra Program ..... Aug 2016 to May 2017

## Missouri State University

Undergraduate Teaching Assistant in Mathematics ..... Jun 2015 to Aug 2016

◇ MTH 101 (Intermediate Algebra A)                      ◇ Center for Learning and Writing liaison

Mathematics Tutor, Bear CLAW (Center for Learning and Writing) ..... Aug 2013 to Aug 2016

◇ MTH 103 (Intermediate Algebra)                      ◇ MTH 261 (Calculus I)  
◇ MTH 135 (College Algebra)                      ◇ MTH 280 (Calculus II)  
◇ MTH 138 (Precalculus)                      ◇ MTH 287 / 288 (Applied Calculus I / II)  
◇ MTH 181 (Trigonometry)                      ◇ MTH 302 (Calculus III)

## AWARDS

---

### Teaching

finalist, Florence Black Award for Excellence in Teaching ..... Apr 2021

### Academic

John Bunce Memorial Award ..... Apr 2022

Elbert Walker Graduate Scholarship in Mathematics ..... May 2021

Rashleigh Family Graduate Scholarship in Mathematics ..... May 2020

May Landis Graduate Scholarship in Mathematics ..... May 2019

U.G. Mitchell Graduate Scholarship in Mathematics ..... May 2019

first place in mathematics, MOState CNAS Undergraduate Research Symposium ..... May 2014

## PROFESSIONAL SERVICE

---

### Leadership and Organization

Panel Chair, Baker University Scholars Symposium ..... Apr 2024

Faculty Judge, Baker University Academic Scholarship Competition ..... Feb 2024

Organizer, Numerical Semigroups Mini-Course ..... Jun to Aug 2023

Faculty Judge, Baker University Academic Scholarship Competition ..... Nov 2022

Organizer, University of Kansas Ph.D Qualifying Exam Study Groups ..... Aug 2018 to May 2022

### Refereeing

International Journal of Number Theory

## RESEARCH

---

### Research Interests

commutative algebra and its connections to combinatorics and additive number theory

### Publications

*Canonical blow-up of one-dimensional singularities* (with Hailong Dao), in progress

**ABSTRACT.** We study the canonical blow-up  $B(\omega_R)$  of an analytically unramified one-dimensional Cohen-Macaulay local ring  $(R, \mathfrak{m}, k)$  with infinite residue field  $k$  and canonical ideal  $\omega_R$ . If  $B(\omega_R)$  is Gorenstein, we say that  $R$  has the *Gorenstein canonical blow-up* (GCB) property. We provide equivalent conditions for GCB rings, and we show Arf rings, nearly Gorenstein rings of minimal multiplicity, far-flung Gorenstein rings, and numerical semigroup rings of multiplicity three are GCB. We study related numerical semigroup rings and give examples.

*On a generalization of two-dimensional Veronese subrings*, in progress

**ABSTRACT.** We investigate certain combinatorial and set-theoretic properties of the sumsets of a subset  $A$  of the discrete interval  $[a] = \{0, 1, \dots, a\}$  for a non-negative integer  $a$ . Particularly, we give bounds on the minimum cardinality of  $A$  for which  $A + A = \{x + y \mid x, y \in A\} = [2a]$ , in which case we say that  $A$  is a *complete double* of  $[a]$ . We connect these properties to the Hilbert series, (Hilbert-Samuel) multiplicity, and regularity of the monomial subring  $R = k[x^i y^{a-i} \mid i \in A] \subseteq k[x, y]$ .

*On threshold properties of the  $n$ -fold sums of a numerical semigroup* (with Srishti Singh), in progress

**ABSTRACT.** If  $S$  is a numerical semigroup with maximal ideal  $S^*$ , the  $n$ -fold sums of  $S$  are numerical semigroups  $\Sigma_n(S) = nS^* \cup \{0\}$  indexed by the positive integers  $n$ . We demonstrate that  $\Sigma_n(S)$  has maximal embedding dimension for all integers  $n \geq e(S) - 1$ , and we provide equivalent conditions for  $\Sigma_2(S)$  to possess maximal embedding dimension when  $S$  is generated by a generalized arithmetic sequence. We investigate also the case that a property  $\mathcal{P}$  of  $S$  holds for its  $n$ -fold sums  $\Sigma_n(S)$ . If  $\Sigma_n(S)$  satisfies  $\mathcal{P}$  for all integers  $n \geq 2$ , we say that  $\mathcal{P}$  is an *inherited* property; if there exists an integer  $k \gg 0$  such that  $\mathcal{P}$  holds for  $\Sigma_n(S)$  for all integers  $n \geq k$ , we say that  $\mathcal{P}$  is a *threshold* property. We demonstrate that Arfness and saturatedness are inherited properties and that the divisiveness of a numerical semigroup generated by an interval or of maximal embedding dimension is inherited.

*The radius of a numerical semigroup*, in progress

**ABSTRACT.** We introduce a new invariant related to the maximal ideal  $S^*$  of a numerical semigroup  $S$  and its Hilbert function. Explicitly, we consider the minimum number of minimal generators of  $S$  such that  $S^* + S^*$  is completely determined; we refer to this number as the *radius* of  $S$ . We prove that the radius of a numerical semigroup generated by a generalized arithmetic sequence is two.

*Some new invariants of Noetherian local rings* (with Souvik Dey), [arXiv: 2205.01658](#)

**ABSTRACT.** We introduce two new invariants of a Noetherian (standard graded) local ring  $(R, \mathfrak{m})$  that measure the number of generators of certain kinds of reductions of  $\mathfrak{m}$ , and we study their properties. Explicitly, we consider the minimum among the number of generators of ideals  $I$  such that either  $I^2 = \mathfrak{m}^2$  or  $I \supseteq \mathfrak{m}^2$  holds. We investigate subsequently the case that  $R$  is the quotient of a polynomial ring  $k[x_1, \dots, x_n]$  by an ideal  $I$  generated by homogeneous quadratic forms, and we compute these invariants. We devote specific attention to the case that  $R$  is the quotient of a polynomial ring  $k[x_1, \dots, x_n]$  by the edge ideal of a finite simple graph  $G$ .

*Equivalence relations induced by functions* (with April Thomas), in progress

**ABSTRACT.** Equivalence relations and functions are ubiquitous throughout pure and applied mathematics, e.g., in calculus, commutative algebra, number theory, and real analysis. Our aim in this work is to understand the relationship between these structures. Concretely, we determine when a relation defined in terms of a function and an equivalence relation is itself an equivalence relation, and we seek to understand the nature of such relations via the properties of the underlying function. We provide examples from combinatorics and number theory.

## Academic Talks

The  $n$ -Fold Sum of a Numerical Semigroup (KU Algebra Day 2023, Nov 2023)

The Radius of a Numerical Semigroup (University of Kansas Algebra Seminar, Nov 2022)

Some New Invariants of Noetherian Local Rings (URiCA, May 2022)

[Canonical Modules](#) (Graduate Student Algebra Seminar, Mar 2022)

Some New Invariants of Edge Rings of Finite Simple Graphs (KU Combinatorics Seminar, Feb 2022)

A Small Survey of Topics in Commutative Algebra (Graduate Student Seminar, Feb 2022)

[The Basics of Homological Algebra](#) (Graduate Student Algebra Seminar, weekly from Feb to Apr 2022)

The Canonical Blow-Up of a Numerical Semigroup (KS Math Graduate Student Conference, Dec 2021)

Canonical Blow-Up of One-Dimensional Singularities (KU Local Algebra Conference, Nov 2021)

[Serre's Condition and Cohen-Macaulayness](#) (Graduate Student Algebra Seminar, Oct 2021)

[Depth, Dimension, and Cohen-Macaulayness](#) (Graduate Student Algebra Seminar, Oct 2021)

[Numerical Semigroup Rings](#) (Commutative Algebra Regional Expository Seminar, Feb 2021)

Loewy Length and the Rees Property (Graduate Student Algebra Seminar, Mar 2020)

Gorenstein Rings and the Canonical Module (Graduate Student Algebra Seminar, Nov 2019)

Cohen-Macaulay Rings and Their Properties (Graduate Student Algebra Seminar, Nov 2019)

Connecting Depth, Ext, and Projective Dimension (Graduate Student Algebra Seminar, Apr 2019)

Banach-Tarski Paradox and Equidecomposable Sets (Graduate Student Seminar, Nov 2018)

Cohen-Macaulay Rings, Depth, and Regular Sequences (Graduate Student Algebra Seminar, Oct 2018)

Ethics in Mathematics: a History of Mathematical Proofs (Graduate Student Seminar, Feb 2018)

Paradoxical Decompositions and the Banach-Tarski Paradox (Graduate Student Seminar, Oct 2016)

On a Quadratic Variant of a Problem of Berzsenyi (Missouri State University College of Natural and Applied Sciences Undergraduate Research Symposium, May 2014)

### **Conferences Attended**

URiCA: Upcoming Researchers in Commutative Algebra (University of Nebraska, May 2023)

KUMUNU Commutative Algebra Conference (University of Nebraska, Oct 2022)

KUMUNU Commutative Algebra Conference (University of Nebraska, May 2022)

Kansas Mathematics Graduate Student Conference (University of Kansas, Dec 2021)

KUMUNU Commutative Algebra Conference (University of Nebraska, Sep 2019)

KUMUNUjr Commutative Algebra Conference (University of Nebraska, Mar 2019)

Southwest Local Algebra Meeting (SLAM) (University of Texas at El Paso, Feb 2019)

KUMUNU Commutative Algebra Conference (University of Kansas, Oct 2018)

Great Plains Combinatorics Conference (GPCC) (Kansas State University, Apr 2018)

Graduate Student Combinatorics Conference (GSCC) (University of Texas at Dallas, Apr 2018)

KUMUNU Commutative Algebra Conference (University of Kansas, Oct 2017)

The Midwest Combinatorics Conference (University of Minnesota, May 2017)