T H E   P E N T A G O N

A   Mathematics   Magazine   for   Students

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The Number of Constant Terms Remaining in a Telescoping Series

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1. Introduction

Telescoping series represent an important area of study in calculus and have been applied to a variety of problems. One recent example is provided [1] where telescoping series have been used to find an alternate solution to the famous Basel problem:

$$\sum_{k=1}^{\infty} \frac{1}{k^2} = \frac{\pi^2}{6}.$$

Traditionally, the topic of telescoping series is covered in the unit on series and sequences in a Calculus II course, and the first example that is usually presented is

$$\sum_{n=1}^{\infty} \frac{1}{n(n+1)}.$$

This series has some interesting geometric interpretations. For instance, Mathews shows in [4] how this series represents the infinite sum of the differences of the family of power curves x^n over the interval $[0, 1]$. These differences partition "the unit square into an infinite number of regions with total area 1." Meanwhile, Franz provides an example in [2] of adjacent telephone poles, equally positioned along a street (one unit between

each pole) extending indefinitely into the horizon. From the perspective of someone standing behind the poles, the sum of the *horizontal* separations of the poles is the telescoping series above.

The traditional way that students learn to find the sum of this series is to use partial fractions to decompose each term so that the series can be rewritten as

$$\sum_{n=1}^{\infty}\left(\frac{1}{n}-\frac{1}{n+1}\right) = \left(1-\frac{1}{2}\right)+\left(\frac{1}{2}-\frac{1}{3}\right)+\cdots+\left(\frac{1}{n}-\frac{1}{n+1}\right)+\cdots.$$

At this point, students are supposed to notice that nearly all terms cancel. Then, when we let $n \to \infty$, the sum is 1, which is the only constant term in the series that does not cancel. Now, considering a slightly different example,

$$\sum_{n=1}^{\infty}\frac{1}{n(n+2)},$$

the result of the decomposition is

$$\sum_{n=1}^{\infty}\frac{1}{2}\left(\frac{1}{n}-\frac{1}{n+2}\right) = \frac{1}{2}\left(1-\frac{1}{3}\right)+\frac{1}{2}\left(\frac{1}{2}-\frac{1}{4}\right)+\cdots+\frac{1}{2}\left(\frac{1}{n}-\frac{1}{n+2}\right)+\cdots.$$

In this example, the final sum is produced by adding the two remaining constant terms, $\frac{1}{2}$ and $\frac{1}{4}$. This specific type of example is addressed by Laval [3] who proves the following result where p is any positive integer:

$$\sum_{i=1}^{\infty}\frac{1}{i(i+p)} = \frac{1}{p}\sum_{i=1}^{p}\frac{1}{i^2}.$$

In this article, we consider the general issue of determining the number of constant terms that remain after eliminating all cancelled terms in the series

$$\sum_{k=0}^{\infty}\frac{1}{(ak+c)(ak+c+d)}, \tag{1}$$

where a, c, and d are positive integers and d is divisible by a. We will, in fact, show that when calculating

$$\lim_{n\to\infty} \sum_{k=0}^{n} \frac{1}{(ak+c)(ak+c+d)},$$

there are $\frac{d}{a}$ terms remaining after all other terms converge to zero. In the process, we will find an explicit formula for the sum.

2. Main Results

We begin by using partial fractions by solving for x and y in

$$\frac{1}{(ak+c)(ak+c+d)} = \frac{x}{ak+c} + \frac{y}{ak+c+d}.$$

Then, $1 = x(ak+c+d)+y(ak+c)$, so that $xa+ya = 0$ and $xc+xd+yc = 1$. From the first equation, we have $x = -y$. Therefore, $xc + xd + yc = 1$, which implies that $xc + xd - xc = 1$, so that $xd = 1$ and $x = \frac{1}{d}$. Then, $y = -\frac{1}{d}$. Then the sum in (1) can be written as

$$\frac{1}{d} \sum_{k=0}^{\infty} \left(\frac{1}{ak+c} - \frac{1}{ak+c+d} \right).$$

Letting $f(k) = \frac{1}{ak+c}$ and $g(k) = \frac{1}{ak+c+d}$, it follows that

$$f\left(k+\frac{d}{a}\right) = \frac{1}{a\left(k+\frac{d}{a}\right)+c} = \frac{1}{ak+d+c} = g(k).$$

Therefore, the sum in (1) can be rewritten as

$$\frac{1}{d} \sum_{k=0}^{\infty} \left(f(k) - g(k) \right).$$

When $n > \frac{d}{a}$, its partial sum s_n can be written as

$$
\begin{aligned}
s_n &= \frac{1}{d}\sum_{k=0}^{n}(f(k) - g(k)) \\
&= \frac{1}{d}\left[\sum_{k=0}^{d/a-1} f(k) + \sum_{k=d/a}^{n} f(k) - \sum_{k=0}^{n} g(k)\right] \\
&= \frac{1}{d}\left[\sum_{k=0}^{d/a-1} f(k) + \sum_{k=0}^{n-d/a} f\left(k + \frac{d}{a}\right) - \sum_{k=0}^{n} g(k)\right] \\
&= \frac{1}{d}\left[\sum_{k=0}^{d/a-1} f(k) + \sum_{k=0}^{n-d/a} g(k) - \sum_{k=0}^{n} g(k)\right] \\
&= \frac{1}{d}\left[\sum_{k=0}^{d/a-1} f(k) - \sum_{k=n-d/a+1}^{n} g(k)\right].
\end{aligned}
$$

This sum converges to

$$
\lim_{n\to\infty} s_n = \lim_{n\to\infty}\frac{1}{d}\left[\sum_{k=0}^{d/a-1} f(k) - \sum_{k=n-d/a+1}^{n} g(k)\right].
$$

We now show that

$$
\lim_{n\to\infty}\sum_{k=n-d/a+1}^{n} g(k) = 0. \tag{2}
$$

First, we note that for all $x > 0$, $g(x) \geq 0$ and $g(x)$ is strictly decreasing. Then, we have

$$
\sum_{k=n-d/a+1}^{n} g(k) \leq \left(\frac{d}{a} - 1\right) g\left(n - \frac{d}{a} + 1\right)
$$

which converges to 0 as $n \to \infty$ which proves (2).

It follows that

$$
\lim_{n\to\infty} s_n = \lim_{n\to\infty}\frac{1}{d}\sum_{k=0}^{d/a-1} f(k) = \frac{1}{d}\sum_{k=0}^{d/a-1} f(k),
$$

a constant with $\frac{d}{a}$ terms. Therefore, the telescoping series converges to a

sum with $\frac{d}{a}$ terms, as desired.

In addition, we have produced the explicit formula for the sum of a telescoping series: If a divides d, the sum is given by

$$\sum_{k=0}^{\infty} \frac{1}{(ak+c)(ak+c+d)} = \frac{1}{d} \sum_{k=0}^{d/a-1} f(k).$$

3. Example

For

$$\sum_{k=0}^{\infty} \frac{1}{(2k+1)(2k+9)},$$

we have $a = 2$, $c = 1$, and $d = 8$, so we would expect $\frac{d}{a} = \frac{8}{2} = 4$ constant terms to remain.

$$\begin{aligned}
\sum_{k=0}^{\infty} \frac{1}{(2k+1)(2k+9)} &= \sum_{k=0}^{\infty} \frac{1}{8}\left[\frac{1}{2k+1} - \frac{1}{2k+9}\right] \\
&= \frac{1}{8}\left[1 - \frac{1}{9}\right] + \frac{1}{8}\left[\frac{1}{3} - \frac{1}{11}\right] + \frac{1}{8}\left[\frac{1}{5} - \frac{1}{13}\right] \\
&\quad + \frac{1}{8}\left[\frac{1}{7} - \frac{1}{15}\right] + \frac{1}{8}\left[\frac{1}{9} - \frac{1}{17}\right] + \frac{1}{8}\left[\frac{1}{11} - \frac{1}{19}\right] + \cdots
\end{aligned}$$

The sum of the series is the sum of the four terms that will never cancel which is

$$\frac{1}{8}(1) + \frac{1}{8}\left(\frac{1}{3}\right) + \frac{1}{8}\left(\frac{1}{5}\right) + \frac{1}{8}\left(\frac{1}{7}\right) = \frac{22}{105}.$$

Evaluating the series now using our explicit formula confirms the result:

$$\frac{1}{d}\sum_{k=0}^{d/a-1} \frac{1}{ak+c} = \frac{1}{8}\left(1 + \frac{1}{3} + \frac{1}{5} + \frac{1}{7}\right) = \frac{22}{105}.$$

Note: If $\frac{d}{a}$ is not an integer, as assumed above, we now show that the series does not telescope.

Suppose that a does not divide d. We note that each term in the expanded series contains the difference $\frac{1}{ak+c} - \frac{1}{ak+c+d}$. Since a does not divide d, there exist positive integers q and r with $d = aq + r$, $0 < r < a$.

Then

$$
\begin{aligned}
\frac{1}{ak+c} - \frac{1}{ak+c+d} &= \frac{1}{ak+c} - \frac{1}{ak+c+aq+r} \\
&= \frac{1}{ak+c} - \frac{1}{a(k+q)+c+r}.
\end{aligned}
$$

Since each positive term in the last difference leaves a remainder of c upon division by a, and the negative term leaves a remainder of c plus another integer (since $0 < r < a$), none of the negative terms will ever cancel any of the positive terms. That is, the series does not telescope.

4. Summary

In this article, we show that for the general telescoping series

$$
\sum_{k=0}^{\infty} \frac{1}{(ak+c)(ak+c+d)},
$$

if a, c, and d are positive integers and a divides d, then there are constant terms remaining after all other terms converge to zero. In addition, we have produced an explicit formula for the sum of the series. In the case that a does not divide d, we show that the series does not telescope.

References

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Several Results of Some Classes of Sequences (Generalizations of Some Problems from The Pentagon)

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1. Introduction

Success in problem solving requires effort. Here the text is especially helpful. There are three important aspects of learning mathematics.

First, one must get the idea or the concept, e.g., from a theorem previously given.

Second, one must practice the skills one hopes to develop and needs for the homework problems in the text (like the problems listed below). Without this skill development, the understanding of the concepts will not get one very far.

The *third* aspect of learning mathematics is the assimilation process which enables one to recognize ideas one has encountered in other contexts and gives one the confidence to make the leap to solving problems, the likes of which someone had not seen before. This is where the problems of the "Problem Solving" journals come in. These are not routine exercises. They are problems whose solutions depend on trying something new ebfore achieving success!

We make the following notations

$$\mathbb{N} = \{0, 1, 2, 3, \ldots\}, \ \mathbb{N}^* = \{1, 2, 3, \ldots\},$$
$$\mathbb{R}_+ = [0, \infty), \ \mathbb{R}_+^* = (0, \infty), \ \forall = \text{for any.}$$

In [5], we proposed

Problem 692. Let $x_n = \sqrt[n]{\sqrt{2!} \cdot \sqrt[3]{3!} \cdot \cdots \cdot \sqrt[n]{n!}}$. Calculate

$$\lim_{n \to \infty} \left(\frac{(n+1)^2}{x_{n+1}} - \frac{n^2}{x_n} \right). \tag{1}$$

In [6], we proposed

Problem 704. Let $(a_n)_{n \geq 1}$, $(b_n)_{n \geq 1}$ be positive real sequences such that

$$\lim_{n \to \infty} \frac{a_{n+1}}{n^2 \cdot a_n} = a \in \mathbb{R}_+^*, \qquad \lim_{n \to \infty} \frac{b_{n+1}}{n^3 \cdot b_n} = b \in \mathbb{R}_+^*.$$

Calculate

$$\lim_{n \to \infty} \left(\sqrt[n+1]{\frac{b_{n+1}}{a_{n+1}}} - \sqrt[n]{\frac{b_n}{a_n}} \right). \tag{2}$$

In [7], we proposed

Problem 715. For $t \geq 1$, we define

$$x_n(t) = n^{1-t} \cdot \left(\frac{\left(\sqrt[n+1]{(n+1)!} \right)^{2t}}{(n+1)^t} - \frac{\left(\sqrt[n]{n!} \right)^{2t}}{n^t} \right). \tag{3}$$

Calculate $\lim_{n \to \infty} x_n(t)$.

We intend to present some generalizations of these limits and to give some applications of these results.

2. Main Results

We denote $S\left(\mathbb{R}_+^*\right) = \{(x_n)_{n \geq 1} \,|\, x_n \in \mathbb{R}_+^*, \forall n \in \mathbb{N}^*\}$, i.e., the set of all positive real sequences $(x_n)_{n \geq 1}$, such that $x_n \in \mathbb{R}_+^*$, $\forall n \in \mathbb{N}^*$. We will deal only with $x_n \in S\left(\mathbb{R}_+^*\right)$.

Definition 1. If $(t, a) \in \mathbb{R}_+ \times \mathbb{R}_+^*$, we will say that the sequence $(a_n)_{n \geq 1} \in S\left(\mathbb{R}_+^*\right)$ has the property $B-(t, a)$, or that $(a_n)_{n \geq 1}$ is a $B-(t, a)$ sequence, if

$$\lim_{n \to \infty} \frac{a_{n+1}}{n^t \cdot a_n} = a \in \mathbb{R}_+^*. \tag{4}$$

Definition 2. If $(s, b) \in \mathbb{R}_+ \times \mathbb{R}_+^*$, we will say that the sequence $(b_n)_{n \geq 1} \in S\left(\mathbb{R}_+^*\right)$ has the property $L-(s, b)$, or that $(b_n)_{n \geq 1}$ is a $L-(s, b)$ sequence, if

$$\lim_{n \to \infty} \frac{b_{n+1} - b_n}{n^s} = b \in \mathbb{R}_+^*. \tag{5}$$

We present below some useful (important) properties of $B - (t, a)$ sequences and of $L - (s, b)$ sequences. Before stating and proving the first such property, we recall the following result of use to the proof of Proposition 1 below.

Cauchy–D'Alembert's Theorem. Let $(a_n)_{n \geq 0}$ be a positive real sequence. If $\lim_{n \to \infty} \frac{a_{n+1}}{a_n}$ exists, then $\lim_{n \to \infty} \sqrt[n]{a_n} = \lim_{n \to \infty} \frac{a_{n+1}}{a_n}$.

Proof of Cauchy–D'Alembert's Theorem. We denote $x_n = \sqrt[n]{a_n}$. We have

$$\ln x_n = \frac{1}{n} \ln a_n. \tag{*}$$

For calculation of the limit of the sequence $\frac{1}{n} \ln a_n$, we shall use Cesaro-Stolz's Lemma:

$$\lim_{n \to \infty} \frac{\ln a_n}{n} = \lim_{n \to \infty} \frac{\ln a_{n+1} - \ln a_n}{(n+1) - n} = \lim_{n \to \infty} \frac{a_{n+1}}{a_n}.$$

Hence,

$$\lim_{n \to \infty} \ln \sqrt[n]{a_n} = \lim_{n \to \infty} \ln \frac{a_{n+1}}{a_n} \iff \ln \lim_{n \to \infty} \sqrt[n]{a_n} = \ln \lim_{n \to \infty} \frac{a_{n+1}}{a_n}$$

$$\iff \lim_{n \to \infty} \sqrt[n]{a_n} = \lim_{n \to \infty} \frac{a_{n+1}}{a_n}. \blacksquare$$

Proposition 1. If $(a_n)_{n \geq 1} \in S\left(\mathbb{R}_+^*\right)$ is a $B - (t, a)$ sequence, then

$$\lim_{n \to \infty} \frac{\sqrt[n]{a_n}}{n^t} = a \cdot e^{-t}. \tag{6}$$

Proof. By Cauchy–D'Alembert's Theorem, we have

$$
\begin{aligned}
\lim_{n\to\infty}\frac{\sqrt[n]{a_n}}{n^t} &= \lim_{n\to\infty}\sqrt[n]{\frac{a_n}{n^{nt}}} \\
&= \lim_{n\to\infty}\left(\frac{a_{n+1}}{(n+1)^{(n+1)t}}\cdot\frac{n^{nt}}{a_n}\right) \\
&= \lim_{n\to\infty}\left(\frac{a_{n+1}}{n^t\cdot a_n}\cdot\left(\frac{n}{n+1}\right)^{(n+1)t}\right) = a\cdot e^{-t}.\ \blacksquare
\end{aligned}
$$

Proposition 2. If $(a_n)_{n\geq1}\in S\left(\mathbb{R}_+^*\right)$ is a $B-(t,a)$ sequence, then and

$$
u_n = \frac{\sqrt[n+1]{a_{n+1}}}{\sqrt[n]{a_n}},\ \ \forall n\in\mathbb{N}^*-\{1\},
$$

then

$$
\lim_{n\to\infty}u_n = 1. \tag{7}
$$

Proof. Because

$$
u_n = \frac{\sqrt[n+1]{a_{n+1}}}{\sqrt[n]{a_n}} = \frac{\sqrt[n+1]{a_{n+1}}}{(n+1)^t}\cdot\frac{n^t}{\sqrt[n]{a_n}}\cdot\left(\frac{n+1}{n}\right)^t,\ \ \forall n\in\mathbb{N}^*-\{1\},
$$

we obtain

$$
\begin{aligned}
\lim_{n\to\infty}u_n &= \lim_{n\to\infty}\frac{\sqrt[n+1]{a_{n+1}}}{(n+1)^t}\cdot\lim_{n\to\infty}\frac{n^t}{\sqrt[n]{a_n}}\cdot\lim_{n\to\infty}\left(\frac{n+1}{n}\right)^t \\
&= a\cdot e^{-t}\cdot\frac{1}{a\cdot e^{-t}}\cdot1 = 1.\ \blacksquare
\end{aligned}
$$

Consequently

$$
\lim_{n\to\infty}\frac{u_n-1}{\ln u_n} = 1. \tag{8}
$$

Proposition 3.

$$\lim_{n \to \infty} u_n^n = e^t. \tag{9}$$

Proof. We have

$$
\begin{aligned}
u_n^n &= \left(\frac{\sqrt[n+1]{a_{n+1}}}{\sqrt[n]{a_n}} \right)^n = \frac{a_{n+1}}{a_n} \cdot \frac{1}{\sqrt[n+1]{a_{n+1}}} \\
&= \frac{a_{n+1}}{n^t \cdot a_n} \cdot \frac{(n+1)^t}{\sqrt[n+1]{a_{n+1}}} \cdot \frac{n^t}{(n+1)^t}, \quad \forall n \in \mathbb{N}^* - \{1\}.
\end{aligned}
$$

Then

$$
\begin{aligned}
\lim_{n \to \infty} u_n^n &= \lim_{n \to \infty} \frac{a_{n+1}}{n^t \cdot a_n} \cdot \lim_{n \to \infty} \frac{(n+1)^t}{\sqrt[n+1]{a_{n+1}}} \cdot \lim_{n \to \infty} \left(\frac{n}{n+1} \right)^t \\
&= a \cdot \frac{e^{-t}}{a} \cdot 1 = e^{-t}. \quad \blacksquare
\end{aligned}
$$

Proposition 4. Let $(t, a), (s, b) \in \mathbb{R}_+ \times \mathbb{R}_+^*$, and $(a_n)_{n \geq 1}, (b_n)_{n \geq 1} \in S\left(\mathbb{R}_+^*\right)$. If $(a_n)_{n \geq 1}$ is a $B - (t, a)$ sequence and $(b_n)_{n \geq 1}$ is a $B - (s, a)$ sequence, then $(a_n b_n)_{n \geq 1}$ is a $B - (t + s, a \cdot b)$ sequence

Proof. We have

$$
\lim_{n \to \infty} \frac{a_{n+1}}{n^t \cdot a_n} = a \in \mathbb{R}_+^*, \quad \text{and} \quad \lim_{n \to \infty} \frac{b_{n+1}}{n^s \cdot b_n} = b \in \mathbb{R}_+^*.
$$

So

$$
\lim_{n \to \infty} \frac{a_{n+1} \cdot b_{n+1}}{n^{t+s} \cdot a_n \cdot b_n} = \lim_{n \to \infty} \frac{a_{n+1}}{n^t \cdot a_n} \cdot \lim_{n \to \infty} \frac{b_{n+1}}{n^s \cdot b_n} = a \cdot b,
$$

i.e., $(a_n b_n)_{n \geq 1}$ is a $B - (t + s, a \cdot b)$ sequence. $\blacksquare$

Proposition 5. Let $(t, a), (s, b) \in \mathbb{R}_+ \times \mathbb{R}_+^*$, and $(a_n)_{n \geq 1}, (b_n)_{n \geq 1} \in S\left(\mathbb{R}_+^*\right)$. If $(a_n)_{n \geq 1}$ is a $B - (t, a)$ sequence and $(b_n)_{n \geq 1}$ is a $B - (s, a)$ sequence, then $\left(\frac{a_n}{b_n} \right)_{n \geq 1}$ is a $B - \left(t - s, \frac{a}{b} \right)$ sequence.

Proof. We have

$$\lim_{n\to\infty} \frac{\frac{a_{n+1}}{b_{n+1}}}{n^{t-s} \cdot \frac{a_n}{b_n}} = \lim_{n\to\infty} \frac{a_{n+1}}{n^t \cdot a_n} \cdot \lim_{n\to\infty} \frac{n^s \cdot b_n}{b_{n+1}} = \frac{a}{b}.$$

Therefore, $\left(\frac{a_n}{b_n}\right)_{n\geq 1}$ is a $B - \left(t - s, \frac{a}{b}\right)$ sequence. $\blacksquare$

Proposition 6. If $(t, b) \in \mathbb{R}_+ \times \mathbb{R}_+^*$, and $(b_n)_{n\geq 1} \in S\left(\mathbb{R}_+^*\right)$ is a $L - (t, b)$ sequence, then

$$\lim_{n\to\infty} \frac{b_n}{n^{t+1}} = \frac{b}{t+1}. \tag{10}$$

Proof. By Cesaro-Stolz's theorem we have

$$
\begin{aligned}
\lim_{n\to\infty} \frac{b_n}{n^{t+1}} &= \lim_{n\to\infty} \frac{b_{n+1} - b_n}{(n+1)^{t+1} - n^{t+1}} \\
&= \lim_{n\to\infty} \frac{b_{n+1} - b_n}{n^t} \cdot \lim_{n\to\infty} \frac{n^t}{(n+1)^{t+1} - n^{t+1}} \\
&= b \cdot \frac{1}{t+1} = \frac{b}{t+1}. \quad \blacksquare
\end{aligned}
$$

Proposition 7. If $(t, b) \in \mathbb{R}_+ \times \mathbb{R}_+^*$, and $(b_n)_{n\geq 1} \in S\left(\mathbb{R}_+^*\right)$ is a $L - (t, b)$ sequence, then

$$\lim_{n\to\infty} \frac{b_{n+1}}{b_n} = 1. \tag{11}$$

Proof. We have

$$
\begin{aligned}
\lim_{n\to\infty} \frac{b_{n+1}}{b_n} &= \lim_{n\to\infty} \left(\frac{b_{n+1}}{(n+1)^{t+1}} \cdot \frac{n^{t+1}}{b_n} \cdot \left(\frac{n+1}{n}\right)^{t+1} \right) \\
&= \frac{b}{t+1} \cdot \frac{t+1}{b} \cdot 1 = 1. \quad \blacksquare
\end{aligned}
$$

Proposition 8. If $(t, b) \in \mathbb{R}_+ \times \mathbb{R}_+^*$, and $(b_n)_{n \geq 1} \in S\left(\mathbb{R}_+^*\right)$ is a $L - (t, b)$ sequence, then

$$\lim_{n \to \infty} \left(\frac{b_{n+1}}{b_n} \right)^n = e^{t+1}. \tag{12}$$

Proof. We have

$$
\begin{aligned}
\lim_{n \to \infty} \left(\frac{b_{n+1}}{b_n} \right)^n &= \lim_{n \to \infty} \left(1 + \frac{b_{n+1} - b_n}{b_n} \right)^n \\
&= \lim_{n \to \infty} \left(\left(1 + \frac{b_{n+1} - b_n}{b_n} \right)^{\frac{b_n}{b_{n+1} - b_n}} \right)^{\frac{n(b_{n+1} - b_n)}{b_n}} \\
&= e^{\lim_{n \to \infty} \frac{n^{t+1}}{b_n} \cdot \lim_{n \to \infty} \frac{b_{n+1} - b_n}{n^t}} = e^{\frac{t+1}{b} \cdot b} = e^{t+1}. \blacksquare
\end{aligned}
$$

Proposition 9. If , $(t, a), (s, b) \in \mathbb{R}_+ \times \mathbb{R}_+^*$, and $(a_n)_{n \geq 1}, (b_n)_{n \geq 1} \in S\left(\mathbb{R}_+^*\right)$, where $(a_n)_{n \geq 1}$ is a $L - (t, a)$ sequence and $(b_n)_{n \geq 1}$ is a $L - (s, b)$ sequence, then $(a_n b_n)_{n \geq 1}$ is a $L - \left(t + s + 1, \frac{ab(t+s+2)}{(t+1)(s+1)} \right)$ sequence.

Proof. We have

$$\frac{a_{n+1} b_{n+1} - a_n b_n}{n^{t+s+1}}$$

$$
\begin{aligned}
&= \frac{b_{n+1}(a_{n+1} - a_n) + a_n(b_{n+1} - b_n)}{n^{t+s+1}} \\
&= \frac{b_{n+1}}{(n+1)^{s+1}} \cdot \frac{a_{n+1} - a_n}{n^t} \cdot \left(\frac{n+1}{n} \right)^{s+1}, \quad \forall n \in \mathbb{N}^*.
\end{aligned}
$$

Then,

$$
\begin{aligned}
\lim_{n \to \infty} \frac{a_{n+1} b_{n+1} - a_n b_n}{n^{t+s+1}} &= \frac{b}{s+1} \cdot a \cdot 1 + \frac{a}{t+1} \cdot b \\
&= ab \left(\frac{1}{s+1} + \frac{1}{t+1} \right) \\
&= \frac{ab(t+s+2)}{(t+1)(s+1)}. \blacksquare
\end{aligned}
$$

Proposition 10. If , $(t,a),(s,b) \in \mathbb{R}_+ \times \mathbb{R}_+^*$, and $(a_n)_{n\geq 1}, (b_n)_{n\geq 1} \in S\left(\mathbb{R}_+^*\right)$, where $(a_n)_{n\geq 1}$ is a $L-(t,a)$ sequence and $(b_n)_{n\geq 1}$ is a $L-(s,b)$ sequence, then $\left(\frac{a_n}{b_n}\right)_{n\geq 1}$ is a $L-\left(t-s-1, \frac{a(s+1)}{b(t+1)}(t-s)\right)$ sequence.

Proof. We have

$$\frac{\frac{a_{n+1}}{b_{n+1}} - \frac{a_n}{b_n}}{n^{t-s-1}}$$

$$= \frac{a_{n+1}b_n - a_n b_{n+1}}{b_n b_{n+1} n^{t-s-1}}$$

$$= \frac{n^{s+1}}{b_n} \cdot \frac{(n+1)^{s+1}}{b_{n+1}} \cdot \left(\frac{n+1}{n}\right)^{s+1} \cdot \frac{a_{n+1}b_n - a_n b_{n+1}}{b_n b_{n+1} n^{t+s+1}}$$

$$= \frac{n^{s+1}}{b_n} \cdot \frac{(n+1)^{s+1}}{b_{n+1}} \cdot \left(\frac{b_n}{n^{s+1}} \cdot \frac{a_{n+1} - a_n}{n^t} - \frac{a_n}{n^{t+1}} \cdot \frac{b_{n+1} - b_n}{n^s}\right),$$

for all $n \in \mathbb{N}^*$. Then,

$$\lim_{n\to\infty} \frac{\frac{a_{n+1}}{b_{n+1}} - \frac{a_n}{b_n}}{n^{t-s-1}} = \frac{s+1}{b} \cdot \frac{s+1}{b} \cdot 1 \cdot \left(\frac{b}{s+1} \cdot a - \frac{a}{t+1} \cdot b\right)$$

$$= \frac{a(s+1)}{b(t+1)}(t-s). \quad \blacksquare$$

Theorem 1. Let $(t,a) \in \mathbb{R}_+ \times \mathbb{R}_+^*$. If $(a_n)_{n\geq 1} \in S\left(\mathbb{R}_+^*\right)$ is a $B-(t+1,a)$ sequence, then $\left(\sqrt[n]{a_n}\right)_{n\geq 2}$ is a $L-(t, a(t+1)e^{-(t+1)})$ sequence.

Proof. We must prove that if $\lim_{n\to\infty} \frac{a_{n+1}}{n^t \cdot a_n} = a \in \mathbb{R}_+^*$, then

$$\lim_{n\to\infty} \frac{\sqrt[n+1]{a_{n+1}} - \sqrt[n]{a_n}}{n^t} = a(t+1) \cdot e^{-(t+1)}. \tag{13}$$

Indeed, we have

$$\frac{\sqrt[n+1]{a_{n+1}} - \sqrt[n]{a_n}}{n^t} = \frac{\sqrt[n]{a_n}}{n^t} \cdot (u_n - 1)$$

$$= \frac{\sqrt[n]{a_n}}{n^t} \cdot \frac{u_n - 1}{\ln u_n} \cdot \ln u_n$$

$$= \frac{\sqrt[n]{a_n}}{n^{t+1}} \cdot \frac{u_n - 1}{\ln u_n} \cdot \ln u_n^n, \quad \forall n \in \mathbb{N}^* - \{1\},$$

and taking the limit with we obtain

$$\lim_{n\to\infty} \frac{\sqrt[n+1]{a_{n+1}} - \sqrt[n]{a_n}}{n^t} = \lim_{n\to\infty} \frac{\sqrt[n]{a_n}}{n^{t+1}} \cdot \lim_{n\to\infty} \frac{u_n - 1}{\ln u_n} \cdot \ln \left(\lim_{n\to\infty} u_n^n \right)$$
$$= ae^{-(t+1)} \cdot 1 \cdot \ln e^{t+1}$$
$$= a(t+1) \cdot e^{-(t+1)}. \quad \blacksquare$$

In the following, for any $(x_n)_{n\geq 1} \in S\left(\mathbb{R}_+^*\right)$, we denote $(x_n!)_{n\geq 1}$ the sequence defined as $x_1! = x_1$, $x_{n+1}! = x_n! x_{n+1}$, $\forall n \in \mathbb{N}^*$; in other words,

$$x_n! = \prod_{k=1}^{n} x_k, \ \forall n \in \mathbb{N}^*. \tag{14}$$

Theorem 2. Let $(s, x) \in \mathbb{R}_+ \times \mathbb{R}_+^*$, and $(x_n)_{n\geq 1} \in S\left(\mathbb{R}_+^*\right)$ be an $L-(s, x)$ sequence. Then, $(x_n!)_{n\geq 1}$ is a $B - \left(s+1, \frac{x}{s+1}\right)$ sequence.

Proof. We must to prove that, if $\lim_{n\to\infty} \frac{x_{n+1} - x_n}{n^s} = x \in \mathbb{R}_+^*$, then

$$\lim_{n\to\infty} \frac{x_{n+1}!}{n^{s+1} \cdot x_n!} = \frac{x}{s+1}.$$

Indeed,

$$\lim_{n\to\infty} \frac{x_{n+1}!}{n^{s+1} \cdot x_n!} = \lim_{n\to\infty} \frac{x_n! x_{n+1}}{n^{s+1} \cdot x_n!}$$
$$= \lim_{n\to\infty} \frac{x_{n+1}}{n^{s+1}}$$
$$= \lim_{n\to\infty} \frac{x_{n+1}}{(n+1)^{s+1}} \cdot \left(\frac{n+1}{n} \right)^{s+1}$$
$$= \frac{x}{s+1} \cdot 1 = \frac{x}{s+1}. \quad \blacksquare$$

3. Applications

Teaching is a dynamic profession involving many aspects such as lecturing, questioning/responding, interpersonal skills and thinking on one's feet.The most inspiring teachers are those who can transmit enthusiasm for their subject to the students. If the teacher cannot get excited about the subject, then why should the students?

We take it as a personal responsibility to pass on to others the techniques and concepts that have been acquired. We attempt to do this in a cheerful way by injecting humor whenever possible. The adopted teaching philosophy can best be summed up by the phrase: teach by example, and that we do here!

We present a method for solving some problems which appeared in problem solving mathematics journals. Here are helpful examples.

A1. Let $(y_n)_{n \geq 2}$, $y_n = \sqrt{2!} \cdot \sqrt[3]{3!} \cdot \cdots \cdot \sqrt[n]{n!}$. Denoting $x_n = \sqrt[n]{y_n}$, $\forall n \geq 2$, we have

$$\frac{(n+1)^2}{x_{n+1}} - \frac{n^2}{x_n} = \frac{(n+1)^2}{\sqrt[n+1]{y_{n+1}}} - \frac{n^2}{\sqrt[n]{y_n}}$$

$$= \sqrt[n+1]{\frac{(n+1)^{2(n+1)}}{y_{n+1}}} - \sqrt[n]{\frac{n^{2n}}{y_n}}, \quad \forall n \geq 2.$$

Denoting $z_n = \frac{n^{2n}}{y_n}$, $\forall n \geq 2$, we have

$$\frac{(n+1)^2}{x_{n+1}} - \frac{n^2}{x_n} = \sqrt[n+1]{z_{n+1}} - \sqrt[n]{z_n}, \quad \forall n \geq 2.$$

Also we have

$$\lim_{n \to \infty} \frac{z_{n+1}}{n \cdot z_n} = \lim_{n \to \infty} \left(\frac{(n+1)^{2(n+1)}}{y_{n+1}} \cdot \frac{y_n}{n^{2n+1}} \right)$$

$$= \lim_{n \to \infty} \left(\left(\frac{n+1}{n} \right)^{2n+1} \cdot \frac{n+1}{\sqrt[n+1]{y_{n+1}}} \right)$$

$$= e^2 \cdot e = e^3,$$

so $(z_n)_{n \geq 2}$ is a $B - (1, e^3)$ sequence. Then, by Theorem 1, the sequence $\left(\sqrt[n]{z_n} \right)_{n \geq 2}$ is a $L - (0, e^3 \cdot 1 \cdot e^{-1})$ sequence, i.e. a $L - (0, e^2)$ sequence.

Therefore,

$$\lim_{n\to\infty} \left(\sqrt[n+1]{z_{n+1}} - \sqrt[n]{z_n} \right) = e^2 \iff \lim_{n\to\infty} \left(\frac{(n+1)^2}{x_{n+1}} - \frac{n^2}{x_n} \right) = e^2,$$

which solves Problem 692 in [5].

A2. If $(a_n)_{n\geq 1}$ is a $B - (2, a)$ sequence, $(b_n)_{n\geq 1}$ is a $B - (3, b)$ sequence, then by Proposition 5, $\left(\frac{b_n}{a_n} \right)_{n\geq 1}$ is a $B - (1, \frac{b}{a})$ sequence, and by Theorem 1, $\left(\sqrt[n]{\frac{b_n}{a_n}} \right)_{n\geq 1}$ is a $L - (0, \frac{b}{ae})$ sequence. In other words,

$$\lim_{n\to\infty} \left(\sqrt[n+1]{\frac{b_{n+1}}{a_{n+1}}} - \sqrt[n]{\frac{b_n}{a_n}} \right) = \frac{b}{ae},$$

which solves Problem 704 in [6].

A3. Let $t \in [1, \infty)$. Calculate

$$\lim_{n\to\infty} n^{1-t} \cdot \left(\frac{\left(\sqrt[n+1]{(n+1)!} \right)^{2t}}{(n+1)^t} - \frac{\left(\sqrt[n]{n!} \right)^{2t}}{n^t} \right),$$

which is the limit in Problem 715 in [7]. We have

$$n^{1-t} \cdot \left(\frac{\left(\sqrt[n+1]{(n+1)!} \right)^{2t}}{(n+1)^t} - \frac{\left(\sqrt[n]{n!} \right)^{2t}}{n^t} \right)$$

$$= n^{1-t} \cdot \left(\sqrt[n+1]{\left(\frac{((n+1)!)^2}{(n+1)^{n+1}} \right)^t} - \sqrt[n]{\left(\frac{(n!)^2}{n^n} \right)^t} \right)$$

$$= \frac{1}{n^{t-1}} \cdot \left(\sqrt[n+1]{\left(\frac{((n+1)!)^2}{(n+1)^{n+1}} \right)^t} - \sqrt[n]{\left(\frac{(n!)^2}{n^n} \right)^t} \right), \quad \forall n \geq 2.$$

Denoting $a_n = \left(\frac{(n!)^2}{n} \right)^t$, we have

$$\lim_{n\to\infty} \frac{a_{n+1}}{n \cdot a_n} = \lim_{n\to\infty} \left(\left(\frac{((n+1)!)^2}{(n+1)^{n+1}} \right)^t \cdot \left(\frac{n^n}{(n!)^2} \right)^t \cdot \frac{1}{n} \right)$$

$$= \lim_{n\to\infty} \left(\frac{n}{n+1} \right)^{(n-1)t} = e^{-t},$$

and so $(a_n)_{n\geq 1}$ is a $B-(1, e^{-t})$ sequence. Then, by Theorem 1, $\left(\sqrt[n]{a_n} \right)_{n\geq 2}$ is a $L-(0, t\cdot e^{-2t})$ sequence. So, the limit of Problem 715 in [7] is $t\cdot e^{-2t}$.

A4. *The limit of Traian Lalescu.*
Prove that

$$\lim_{n\to\infty} \left(\sqrt[n+1]{(n+1)!} - \sqrt[n]{n!} \right) = \frac{1}{e}.$$

Proof. Let $a_n = n!$, $n \in \mathbb{N}^*$. Then

$$\lim_{n\to\infty} \frac{a_{n+1}}{n \cdot a_n} = \lim_{n\to\infty} \frac{(n+1)!}{n! n} = \lim_{n\to\infty} \frac{n+1}{n} = 1.$$

Thus, the sequence $(a_n)_{n\geq 1}$ is a $B - (1, 1)$ sequence, and so by Theorem 1, yields that the sequence $\left(\sqrt[n]{a_n} \right)_{n\geq 2}$ is a $L - (0, e^{-1})$ sequence. In other words,

$$\lim_{n\to\infty} \left(\sqrt[n+1]{(n+1)!} - \sqrt[n]{n!} \right) = e^{-1},$$

which solves Problem 579 in [4] (see also [1]).

A5. *The limit of Romeo Ianculescu.*
Prove that

$$\lim_{n\to\infty} \left((n+1) \cdot \sqrt[n+1]{n+1} - n \cdot \sqrt[n]{n} \right) = 1.$$

Proof. We have

$$(n+1) \cdot \sqrt[n+1]{n+1} - n \cdot \sqrt[n]{n} = \sqrt[n+1]{(n+1)^{n+2}} - \sqrt[n]{n^{n+1}}$$

$$= \sqrt[n+1]{a_{n+1}} - \sqrt[n]{a_n},$$

where $a_n = n^{n+1}, \forall n \in \mathbb{N}^* - \{1\}$. Now, we have

$$\lim_{n \to \infty} \frac{a_{n+1}}{n \cdot a_n} = \lim_{n \to \infty} \frac{(n+1)^{n+2}}{n \cdot n^{n+1}} = \lim_{n \to \infty} \left(\frac{n+1}{n} \right)^{n+2} = e,$$

and so $(a_n)_{n \geq 2}$ is a $B - (1, e)$ sequence. By Theorem 1, this yields that $\left(\sqrt[n]{a_n} \right)_{n \geq 2}$ is a $L - (0, e \cdot 1 \cdot e^{-1})$ sequence. Hence,

$$\lim_{n \to \infty} \left(\sqrt[n+1]{a_{n+1}} - \sqrt[n]{a_n} \right) = e \cdot 1 \cdot e^{-1} = 1,$$

which solves Problem 2042 in [3] (see also [1]).

A6. *The limit of D. M. Bătineţu – Giurgiu.*
Prove that

$$\lim_{n \to \infty} \left(\frac{(n+1)^2}{\sqrt[n+1]{(n+1)!}} - \frac{n^2}{\sqrt[n]{n!}} \right) = e.$$

Proof. We have

$$\frac{(n+1)^2}{\sqrt[n+1]{(n+1)!}} - \frac{n^2}{\sqrt[n]{n!}} = \sqrt[n+1]{\frac{(n+1)^{2(n+1)}}{(n+1)!}} - \sqrt[n]{\frac{n^{2n}}{n!}} = \sqrt[n+1]{a_{n+1}} - \sqrt[n]{a_n},$$

where $a_n = \frac{n^{2n}}{n!}, \forall n \geq 2$. So,

$$\begin{aligned} \lim_{n \to \infty} \frac{a_{n+1}}{n \cdot a_n} &= \lim_{n \to \infty} \frac{(n+1)^{2(n+1)}}{(n+1)!} \cdot \frac{n!}{n^{2n} \cdot n} \\ &= \lim_{n \to \infty} \left(\frac{n+1}{n} \right)^{2n+1} = e^2. \end{aligned}$$

Therefore, the sequence $(a_n)_{n \geq 2}$ is a $B - (1, e^2)$ sequence. Hence, by Theorem 1, the sequence $\left(\sqrt[n]{a_n} \right)_{n \geq 2}$ is a $L - (0, e^2 \cdot 1 \cdot e^{-1})$ sequence. Thus,

$$\lim_{n \to \infty} \left(\sqrt[n+1]{a_{n+1}} - \sqrt[n]{a_n} \right) = e,$$

which solves Problem C:890 in [2].

References

[1] Bătineţu, M. D., *Sequences*, Albatros Publishing, Bucharest, 1979.

[2] Bătineţu - Giurgiu, M.D., Problem C:890, *Romanian Mathematical Gazette*, Vol. XCIV, No. 4, p. 139, 1989.

[3] Ianculescu, R., Problem 2042, *Romanian Mathematical Gazette*, Vol. XIX, p. 160, 1913 – 1914.

[4] Lalescu, T., Problem 579, *Romanian Mathematical Gazette*, Vol. VI, p. 148, 1900 – 1901.

[5] Problem 692, *The Pentagon*, Fall 2011, p. 54.

[6] Problem 704, *The Pentagon*, Spring 2012, p. 42.

[7] Problem 715, *The Pentagon*, Fall 2012, p. 44.

The Problem Corner

Edited by Pat Costello

The Problem Corner invites questions of interest to undergraduate students. As a rule, the solution should not demand any tools beyond calculus and linear algebra. Although new problems are preferred, old ones of particular interest or charm are welcome, provided the source is given. Solutions should accompany problems submitted for publication. Solutions of the following new problems should be submitted on separate sheets before March 1, 2015. Solutions received after this will be considered up to the time when copy is prepared for publication. The solutions received will be published in the Spring 2015 issue of *The Pentagon*. Preference will be given to correct student solutions. Affirmation of student status and school should be included with solutions. New problems and solutions to problems in this issue should be sent to Pat Costello, Department of Mathematics and Statistics, Eastern Kentucky University, 521 Lancaster Avenue, Richmond, KY 40475-3102 (e-mail: pat.costello@eku.edu, fax: (859) 622-3051).

NEW PROBLEMS 740-748

Problem 740. *Proposed by Tom Moore, Professor Emeritus, Bridgewater State University, Bridgewater, MA.*

Let $\tau(n)$ be the number of different divisors of the positive integer n and let $\varphi(n)$ be Euler's totient function (the number of integers less than n that are relatively prime to n).

1. Prove that there are infinitely many n such that $\tau(n) = \tau(\tau(2015n))$.

2. Prove that there are infinitely many n such that $\tau(n) = \varphi(\tau(2015n))$.
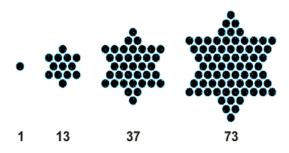
Problem 741. *Proposed by Tom Moore, Professor Emeritus, Bridgewater State University, Bridgewater, MA.*

Let $O_n = n(n + 1)$ be the nth oblong number, for $n = 1, 2, 3, \ldots$. Show that there are infinitely many pairs of distinct oblong numbers O_a, O_b and O_c, O_d with $c > d$, such that $O_a + O_b = O_c - O_d$.

Problem 742. *Proposed by Tom Moore, Professor Emeritus, Bridgewater State University, Bridgewater, MA.*

The star numbers are given by the formula for nonnegative integers.

These begin $1, 13, 37, 73, ...$ and are called star numbers because they can be pictured like we show here for the first few of them:

1. Prove that infinitely many of these numbers are divisible by 11 and infinitely many are divisible by 13 but none are divisible by 17 and none by 19.

2. Prove that infinitely many star numbers are the odd legs of primitive Pythagorean triples (PPTs).

Problem 743. *Proposed by Jose Luis Diaz-Barrero, BARCELONA TECH, Barcelona, Spain.*

Find all real solutions of the equation $8^x + 15^x = 17^x$.

Problem 744. *Proposed by Jose Luis Diaz-Barrero, BARCELONA TECH, Barcelona, Spain.*

Let $n \geq 3$ be a positive integer. Prove that

$$\frac{1}{2}\left(\frac{F_n + L_n}{P_{n+1}^2 + P_{n+1}P_n + F_nL_n}\right) + \frac{1}{2}\left(\frac{L_n + P_n}{P_{n+1}^2 + P_{n+1}F_n + L_nP_n}\right) +$$
$$\frac{1}{2}\left(\frac{P_n + F_n}{P_{n+1}^2 + P_{n+1}L_n + P_nF_n}\right) < \frac{1}{P_{n+1}},$$

where F_n, L_n, and P_n are the nth Fibonacci, Lucas, and Pell numbers, respectively.

Problem 745. *Proposed by Robert Gardner and William Frazier (student), East Tennessee State University, Johnson City, Tennessee.*

Consider the group G being the reals under addition. Define the set $X = \{10^{-n} \mid n \in \mathbb{N}\}$. Denote the subgroup of G generated by X as F. Describe the elements of F. Describe the subsets of X which also generate F and justify your answer. You may assume that F is the group

$\{\cap H \mid X \subseteq H, H$ is a subgroup of $G\}$ and that the elements of F are exactly the finite sums of elements of X and additive inverses of elements of X.

Problem 746. *Proposed by Mohammad K. Azarian, University of Evansville, Evansville, Indiana.*

On January 1, 2014, Camran borrowed $\$50,000$ from three of his best friends, Jacob, Jeff, and Brock, to start his own small company. He agreed to pay back the entire amount to each of his friends on December 31, 2014. The annual rate of interest on each of these loans is 0.9%, 1%, and 1.2%, respectively. According to his calculation, he will be paying 1.04% interest on the total amount borrowed. If the amount that he borrowed from Jeff is $2\frac{1}{2}$ times the amount that he borrowed from Jacob, how much did he borrow from each of his friends?

Problem 747. *Proposed by Ovidiu Furdiu, Technical University of Cluj-Napoca, Cluj, Romania.*

Let $f : [0, 1] \to \mathbb{R}$ be the function $f(x) = \sqrt{\frac{1+x}{2}}$.

1. Determine the function $f^n = f \circ f \circ \cdots \circ f$.

2. Calculate $\lim_{n \to \infty} 4^n (1 - f^n(x))$ for $x \in [0, 1]$.

Problem 748. *Proposed by the editor.*

Find the line that goes through the point $(1, 1)$ which has area under the line in the first quadrant equal to $\frac{5}{2}$.

SOLUTIONS TO PROBLEMS 722-729

Problem 722. *Proposed by Tom Moore, Bridgewater State University, Bridgewater, MA.*

Characterize those positive integers n for which $2^{n^2} + 1$ may be a prime number.

Solution *by D.M. Batinetu-Giurgiu, "Matei Basarab" National College, Bucharest, Romania, Neculai Stanciu, "George Emil Palade", Buzau, Romania, and Titu Zvonaru, Comanesti, Romania.*

The number $2^{n^2} + 1$ is prime for $n = 1$ giving the prime 3. We shall

prove that if n is not a power of two, then $2^{n^2} + 1$ is composite. Let $n = 2^t * s$ where $t \geq 0$, and $s > 1$ is odd. We have that $2^{n^2} + 1 = \left(2^{2^t}\right)^s + 1 = \left(\left(2^{2^t} + 1\right) - 1\right)^s + 1 = M\left(2^{2^t} + 1\right) + (-1)^s + 1 = M\left(2^{2^t} + 1\right)$, so it is composite.

In fact, $n = 2$ gives 17 and $n = 4$ yields the prime 65537. However, $n = 8$ yields a number divisible by 274177. The proposer has not found another instance that yields a prime.

Problem 723. *Proposed by Tom Moore, Bridgewater State University, Bridgewater, MA.*

Prove that there are infinitely many primitive Pythagorean triples (a, b, c), like $(5, 12, 13)$, with hypotenuse c such that the odd leg is a pentagonal number and the even leg is consecutive with the hypotenuse.

Solution *by the Intro to Proof class Fall 2013, Northeastern State University, Tahlequah, OK.*

Consider the right triangles with even leg $b = 2k$, hypotenuse $c = 2k + 1$, odd leg a being the pentagonal number $a_n = \frac{n(3n-1)}{2}$. The odd pentagonal numbers a_n can be partitioned into two sets by

$$
\begin{aligned}
n &= 2 + 4p \text{ with } p = 0, 1, 2, \ldots \\
n &= 5 + 4m \text{ with } m = 0, 1, 2, \ldots
\end{aligned}
$$

If $n = 5 + 4m$, then

$$
a_n = \frac{n(3n-1)}{2} = \frac{(5 + 4m)[3(5 + 4m) - 1]}{2} = 24m^2 + 58m + 35.
$$

We now solve $a^2 + b^2 = c^2$:

$$
(24m^2 + 58m + 35)^2 + (2k)^2 = (2k + 1)^2 \implies
$$

$$
576m^4 + 2784m^3 + 5044m^2 + 4060m + 1225 + 4k^2 = 4k^2 + 4k + 1
$$

So $k = 144m^4 + 696m^3 + 1261m^2 + 1015m + 306$ works. Since the equation has a positive integer solution for $m = 0, 1, 2, \ldots$, there are infinitely many Pythagorean triples of the desired form.

Also solved by D.M. Batinetu-Giurgiu, "Matei Basarab" National College, Bucharest, Romania, Neculai Stanciu, "George Emil Palade", Buzau, Romania, and Titu Zvonaru, Comanesti, Romania; Frank P. Battles, Plymouth, MA; and the proposer.

Problem 724. *Proposed by Tom Moore, Bridgewater State University, Bridgewater, MA..*

Let $T_n = \frac{n(n+1)}{2}$ be the nth triangular number. Prove that the fraction

$$\frac{T_2 T_4 T_6 \cdots T_{2n}}{T_1 T_3 T_5 \cdots T_{2n-1}}$$

is always an integer.

Solution *by Bishal Karanjit (student) and Mulugeta Markos, North Carolina Wesleyan College, Rocky Mount, NC.*

Let

$$S_n = \frac{\displaystyle\prod_{i=1}^{n} T_{2i}}{\displaystyle\prod_{i=1}^{n} T_{2i-1}} = \frac{T_2 T_4 T_6 \cdots T_{2n}}{T_1 T_3 T_5 \cdots T_{2n-1}}.$$

We want to show $S_n = 2n + 1$ for any positive integer n which implies that it is always an integer. We proceed by induction.

If $n = 1$, then $S_1 = \frac{T_2}{T_1} = \frac{3}{1} = 2 * 1 + 1$, and the formula is true for $n = 1$.

Assume the formula is true for some positive integer $n \geq 1$. Then

$$\begin{aligned}
S_{n+1} &= \frac{\displaystyle\prod_{i=1}^{n+1} T_{2i}}{\displaystyle\prod_{i=1}^{n+1} T_{2i-1}} = \frac{\displaystyle\prod_{i=1}^{n} T_{2i}}{\displaystyle\prod_{i=1}^{n} T_{2i-1}} * \frac{T_{2n+2}}{T_{2n+1}} \\
&= (2n+1) * \frac{\frac{(2n+2)(2n+3)}{2}}{\frac{(2n+1)(2n+2)}{2}} = 2n + 3 = 2(n+1) + 1.
\end{aligned}$$

Hence by the principle of mathematical induction, the formula is true for all positive integers n. The fraction is always an integer.

Also solved by Juan Gabriel Alonso, Garoe Secondary School, Las Palmas de Gran Canaria, Spain; Ashland University Undergraduate Problem Solving Group, Ashland, OH; D.M. Batinetu-Giurgiu, "Matei Basarab" National College, Bucharest, Romania, Neculai Stanciu, "George Emil Palade", Buzau, Romania, and Titu Zvonaru, Comanesti, Romania; Frank P. Battles, Plymouth, MA; Dylan Beck, Missouri State University, Springfield, MO; Ioan Viorel Codreanu, Satulung, Maramures, Romania; Missouri State University Problem Solving Group, Springfield, MO; Angel

Plaza, Universidad de Las Palmas de Gran Canaria, Spain; Steven Sly (student), Northeastern State University, Tahlequah, OK; Bill Yankosky, North Carolina Wesleyan College, Rocky Mount, NC; and the proposer

Problem 725. *Proposed by Tom Moore, Bridgewater State University, Bridgewater, MA.*

It is known that each integer $n > 11$ is the sum of two composite numbers but the usual proof of this uses two different expressions, one for n even and one for n odd. If we restrict our attention to certain sequences of the natural numbers, then we can find one expression for each of the numbers in the sequence as a sum of two composite numbers, regardless of parity. Do this for the squares greater than 9 and the triangular numbers greater than 10.

Solution *by Frank P. Battles, Plymouth, MA.*

Case of squares: Let $X^2 > 9$ represent the square of an integer. Let Y represent any integer with $1 < Y < X - 1$. Then,

$$X^2 = X^2 - 2XY + Y^2 + 2XY - Y^2 = (X - Y)^2 + (2X - Y)Y.$$

Since $X - Y$, $2X - Y$, and Y are all greater than 1, we are done.

Case of triangular numbers: Let T_n ($n > 5 \implies T_n > 1$) represent the nth triangular number. Then,

$$\begin{aligned} T_n &= T_n - T_{n-3} + T_{n-3} \\ &= \frac{n(n+1)}{2} - \frac{(n-3)(n-2)}{2} + \frac{(n-3)(n-2)}{2} \\ &= 6(n-1) + T_{n-3}. \end{aligned}$$

We note that T_{n-3} is inductively composite for $n > 5$, and then we are done.

Also solved by D.M. Batinetu-Giurgiu, "Matei Basarab" National College, Bucharest, Romania, Neculai Stanciu, "George Emil Palade", Buzau, Romania, and Titu Zvonaru, Comanesti, Romania; and the proposer.

Problem 726. *Proposed by Jose Luis Diaz-Barrero, BARCELONA TECH, Barcelona, Spain.*

Let x, y, and z be positive real numbers. Prove that

$$\left(\frac{1}{x} + \frac{1}{y} + \frac{1}{z} \right) \left(\frac{xy}{y+z} + \frac{yz}{z+x} + \frac{zx}{x+y} \right) \geq \frac{9}{2}.$$

Solution *by Minh Bui (student), Pittsburg State University, Pittsburg, KS.*

First, we have

$$\left(\frac{1}{x}+\frac{1}{y}+\frac{1}{z}\right) = \frac{1}{2}\left(\frac{y}{xy}+\frac{z}{xz}+\frac{x}{xy}+\frac{z}{zy}+\frac{x}{xz}+\frac{y}{xy}\right)$$

$$= \frac{1}{2}\left(\frac{x+y}{xy}+\frac{y+z}{yz}+\frac{z+x}{xz}\right).$$

Next, apply the arithmetic-geometric mean inequality $a+b+c \geq 3\sqrt[3]{abc}$ to obtain

$$\left(\frac{1}{x}+\frac{1}{y}+\frac{1}{z}\right)\left(\frac{xy}{y+z}+\frac{yz}{z+x}+\frac{zx}{x+y}\right)$$

$$= \frac{1}{2}\left(\frac{x+y}{xy}+\frac{y+z}{yz}+\frac{z+x}{xz}\right)\left(\frac{xy}{y+z}+\frac{yz}{z+x}+\frac{zx}{x+y}\right)$$

$$\geq \frac{9}{2}\sqrt[3]{\frac{x+y}{xy}\frac{y+z}{yz}\frac{z+x}{xz}}\sqrt[3]{\frac{xy}{y+z}\frac{yz}{z+x}\frac{zx}{x+y}} \geq \frac{9}{2}.$$

Also solved by D.M. Batinetu-Giurgiu, "Matei Basarab" National College, Bucharest, Romania, Neculai Stanciu, "George Emil Palade", Buzau, Romania, and Titu Zvonaru, Comanesti, Romania; Ioan Viorel Codreanu, Satulung, Moramures, Romania; Angel Plaza, Universidad de Las Palmas de Gran Canaria, Spain; and the proposer.

Problem 727. *Proposed by Jose Luis Diaz-Barrero, BARCELONA TECH, Barcelona, Spain.*

Let α, β, γ be the measure of the angles of a triangle ABC. Prove that

$$\sum_{cyclic} \frac{\sin\alpha}{4\sin\beta+5\sqrt{\sin\alpha\sin\beta}} \geq \frac{1}{3}.$$

Solution *by Angel Plaza, Universidad de Las Palmas de Gran Canaria, Spain.*

By the Law of Sines, the proposed inequality may be written as

$$\sum_{cyclic} \frac{a}{4b+5\sqrt{ab}} \geq \frac{1}{3},$$

where a, b, c are the three side lengths of triangle ABC. By the AM-GM

inequality $\sqrt{ab} \leq \frac{a+b}{2}$, we have

$$\sum_{cyclic} \frac{a}{4b + 5\sqrt{ab}} \geq \sum_{cyclic} \frac{2a}{5a + 13b}.$$

We may consider new variables $x = \frac{b}{a}$, $y = \frac{c}{b}$, $z = \frac{a}{c}$, where x, y, z are positive and $xyz = 1$. The inequality now reads as

$$\sum_{cyclic} \frac{2}{5 + 13x} \geq \frac{1}{3}.$$

Since the function $f(x) = \frac{2}{5+13x}$ is decreasing and convex on $(0, 1]$, $\min f(x) = f(1) = \frac{1}{9}$. The last inequality is then true.

Also solved by D.M. Batinetu-Giurgiu, "Matei Basarab" National College, Bucharest, Romania, Neculai Stanciu, "George Emil Palade", Buzau, Romania, and Titu Zvonaru, Comanesti, Romania; Ioan Viorel Codreanu, Satulung, Moramures, Romania; and the proposer.

Problem 728. *Proposed by Ovidiu Furdiu, Technical University of Cluj-Napoca, Cluj, Romania.*

Calculate the integral

$$\int_0^1 (-1)^{\lfloor \frac{1}{x} \rfloor} \, dx.$$

Solution *by the Pittsburg State University Math Problem Solving Group, Pittsburg, KS.*

We first obtain an infinite series for the integral in the following manner:

$$\int_0^1 (-1)^{\lfloor \frac{1}{x} \rfloor} \, dx = \sum_{n=1}^{\infty} \int_{\frac{1}{n+1}}^{\frac{1}{n}} (-1)^{\lfloor \frac{1}{x} \rfloor} \, dx = \sum_{n=1}^{\infty} (-1)^n \left(\frac{1}{n} - \frac{1}{n+1} \right).$$

Using the fact that

$$\ln(2) = \sum_{n=1}^{\infty} (-1)^{n+1} \frac{1}{n},$$

we obtain

$$\sum_{n=1}^{\infty} (-1)^n \left(\frac{1}{n} - \frac{1}{n+1} \right) = -\ln(2) - (\ln(2) - 1) = 1 - 2\ln(2).$$

Also solved by Frank P. Battles, Plymouth, MA; Missouri State University Problem Solving Group, Springfield, MO; OK Alpha Chapter, Northeast-

ern State University, Tahlequah, OK; Angel Plaza, Universidad de Las Palmas de Gran Canaria, Spain; Pedro Rodrigues de Rivera (student), Universidad de Las Palmas de Gran Canaria, Spain; and the proposer.

Problem 729. *Proposed by the editor.*

Find the number of distinct 5-letter strings that can be made from the letters in the word TENNESSEE. The two strings EENNE and ENENE are among the strings to count.

Solution *by the Missouri State University Problem Solving Group, Springfield, MO.*

This is a straightforward application of exponential generating functions. The exponential generating function for a sequence a_n is the infinite series $\sum_{n=0}^{\infty} \frac{a_n}{n!}$. The exponential generating function for the number of words of length n consisting of at most one T is $1 + x$. The exponential generating function for the number of words of length n consisting of at most two N's (or two S's) is $1 + x + \frac{x^2}{2!}$. The exponential generating function for the number of words of length n consisting of at most four E's is $1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!}$. To get the generating function for a_n the number of words of length n with at most one T, two N's, two S's and four E's, we multiply the constituent generating functions together obtaining

$$
\sum_{n=0}^{\infty} \frac{a_n}{n!}
$$

$$
= (1+x)\left(1 + x + \frac{x^2}{2!}\right)\left(1 + x + \frac{x^2}{2!}\right)\left(1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!}\right)
$$

$$
= 1 + 4x + \frac{15x^2}{2} + \frac{26x^3}{3} + \frac{163x^4}{24} + \frac{91x^5}{24} +
$$

$$
\frac{37x^6}{24} + \frac{11x^7}{25} + \frac{3x^8}{32} + \frac{x^9}{96}.
$$

Equating coefficients and clearing denominators gives $a_1 = 4$, $a_2 = 15$, $a_3 = 52$, $a_4 = 163$, and $a_5 = 455$. There are 455 5-letter strings.

Also solved by Seidina Conley (student), John Charles Leabo (student), Ada Mapes (student), Alley Rice (student), Nathan Russell (student), Eastern Kentucky University, Richmond, KY; Ed Wilson, Eastern Kentucky University, Richmond, KY; Bill Yankosky, North Carolina Wesleyan College, Rocky Mount, NC; and the proposer.

Errata: .

With sincere apologies:

1. Neculai Stanciu, "George Emil Palade" School, Buzau, Romania and Tito Zvonaru, Comanesti, Romania were erroneously omitted as solvers of Problems 711, 712, 714, 718, and 719 in the previous issue.

2. In the solution to Problem 713, the second paragraph should start "Consider 2^n for n a natural number."

Kappa Mu Epsilon News

Edited by Peter Skoner, Historian

Updated information as of June 2014

Send news of chapter activities and other noteworthy KME events to

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Loretto, PA 15940
or to
pskoner@francis.edu

Installation Report

South Dakota Beta Chapter
Black Hills State University

The installation of the South Dakota Beta Chapter of Kappa Mu Epsilon was held in Club Buzz on the campus of Black Hills State University in Spearfish, SD on Friday, September 20, 2013. The afternoon began with the installation, which was conducted by Dr. Dan Swenson and the installing officer was National President Rhonda McKee. Then came a mathematical talk by Dr. McKee. The following students were initiated as the charter members. (Those who were also installed as officers are noted below.)

Kelsey Dalzell (Secretary)	Shalayne Mowry
Jason Gifford (Treasurer)	Rachel Solano (President)
Keenan Justice	Zachary Zenk (Vice President)

Kristel Ehrhardt was installed as the corresponding secretary and Hui Ma as the faculty sponsor.

The following faculty were initiated as charter members:

Kristel Ehrhardt	Hui Ma
Daluss Siewert	Jill Trimble

The President Dr. Kay Schallenkamp, the Vice President for Academic Affairs Dr. Curtis Card, and the Dean of the College of Liberal Arts Dr. David Wolff, and other guests also attended the proceedings.

Chapter News

AL Alpha – Athens State University
Corresponding Secretary – Patricia Glaze; 17 New Members
New Initiates - Kathryn E. Allison, Clint Billingsley, Britney Braund, Jacqueline Brown, Tyler Blake Calvert, Sarah Montine Cox, Casey Wayne Gaddis, Rebecca Deanna Harper, Cory Meyer, Brad Mitchell, Tanya Marie Sanderson, Tristan Ravae Shields, Leslie Benefield Shockley, Miranda Thomas, Kelsey Michelle Turner; Christopher D. Vaughn, and Joshua Young.

AL Beta – University of North Alabama
Corresponding Secretary – Ashley Johnson; 25 New Members
New Initiates - Monica Achard, Jeffrey Allen, Lauryn Ayers, James M. Beaver, Kelsey Brown, Katherine Coggins, Joseph Cole, Elly Couch, William A. Craft, Kayla Dailey, Sharon Eccleston, Alexander Edwards, Jake Harrington, Leslie Harvey, Ashley Johnson, Elizabeth Kee, David Lundberg, Audrey McGee, Autumn McMunn, Benjamin Moore, Austin Oldag, Matthew Pettus, Kathryn Russell, Andrea Shipley, and Hannah Williams.

AL Gamma – University of Montevallo
Chapter President – John Petters
Other Fall 2013 Officers: Stephanie Dorough, Vice President; and Scott Varagona, Corresponding Secretary

AL Zeta – Birmingham-Southern College
Chapter President – Huda Qureshi; 22 New Members
Other Fall 2013 Officers: Andrew Conner, Vice President; Chase Hoffman, Secretary; Allison Russell Treasurer; Kaitlyn Flagg, Executive Council; and Maria Stadnik, Corresponding Secretary and Faculty Sponsor
The Fall 2013 KME colloquium speaker was Jerome Goddard II from Auburn University Montgomery. He gave an exciting and informative talk entitled "Where have all the tuna fish gone? Can mathematics help explain this crisis?" He discussed modeling of tuna fish populations using reaction diffusion equations and discussed current research on the topic that he is performing with his undergraduates.
New Initiates - Ian Gregory Babcock Adams, Laura Clontz, John Crain, Julia Creager, Andy Crowder, Jim Crowder, Samuel Allen Crowder, James O. Duggan, Adam Eiring, Alex Fawal, Paisley Harrell, Tyler Johnson, Hagen Mancuso, Sean J. McCarthy, Brian Moody, Tripp Morson, Blake Nuwayhid, Laura Oliveros, Nirja Patel, Visvanathen Subramaniam, Andrew Wisecarver, and Mandy Wu.

AL Theta – Jacksonville State University
Chapter President – Shannon Bolton; 50 Current Members; 33 New Members
Other Fall 2013 Officers: Kristen Carlisle, Vice President; Noel Overton, Secretary; Kaitlyn Ledbetter, Treasurer; Dr. David Dempsey, Correspond-

ing Secretary and Faculty Sponsor

The Alabama Theta chapter is planning the annual Spring Initiation Ceremony for February 24, 2014. We have designed a chapter T-shirt, which will be ordered in time for this ceremony. Events scheduled for Fall semester include Game Night in September, Dinner and Drama in October (attending a university drama department production), and Pizza/Game Night in December. Bowling is planned for early spring. In addition, the Alabama Theta chapter members, students and faculty alike, are working hard to prepare for the 2014 KME National Convention, which will be hosted by our chapter; students are planning for Thursday night social activities, including trivia and a photo scavenger hunt. We are excited to welcome everyone to Alabama in April!

New Initiates - David James Akin, Marlee Bell, Jared Reese Benedict, Amy Blount, Allison Lakay Bryan, Steven Matthew Chubay, Brittany M. Conner, Cody Justin Coots, James Tucker Davis, Christine Vernice Fowler, Dustin Allen Gaskins, Wesley Kyle Gay, Keaton Brooks Glass, James H. Green, Corey Thomas Hancock, Kisha Hass, Whitney Elizabeth Henson, Holly Erin Johnson, Darren Lee Johnston, Stephen Kobsa, Jeremy Leshko, Danleigh Rachel McDaniel, Ashlee Nicole Milam, Amanda L. Parker, Andrew Kyle Patrick, Kristen Leigh Pender, Rebecca Marie Peters, Alix Rosarion, Amber Marie Usrey, Dan Wang, Andrew Thomas Wood, Linda Katherine Wood, and Andrew Drake Zammit.

AR Beta – Henderson State University

Chapter President – Katie Robers; 12 Current Members; 4 New Members

Other Fall 2013 Officers: Samantha Lemp, Vice President; James Easterling III, Secretary; Erin Yancey, Treasurer; Dr. Fred Worth, Corresponding Secretary; and Carolyn Eoff, Faculty Sponsor

The Fall 2013 KME initiation ceremony was held on November 21, 2013 in the Ross Room. The welcome address was presented by Dr. John Hardee, Dean of the Ellis College of Arts & Science.

New Initiates - Conner J. Brackhahn, Spenser R. Scroggins, Sara R. Watkins, and Jacob A. Woodall.

CA Epsilon - California Baptist University

Corresponding Secretary – James Buchholz; 11 New Members

New Initiates - Stephanie Dennis, Andrea Eyre, Benon Garuka, Mary Hanson, Jacqueline Hernandez, Leah Malana, Bernard Ngabonziza, Pedro Piqueras, Seth Rankin, Jeanine Rioux, and Alexandria Taylor.

CA Zeta – Simpson University

Faculty Sponsor – Michael Kelly; 1 Current Member

We have been inactive but plan to be active again in the fall.

FL Beta – Florida Southern College

Chapter President –Desiree Ippolito; 21 Current Members; 5 New Mem-

bers

Other Fall 2013 Officers: Jamie Lamar, Vice President; Christopher Morgan, Treasurer; and Aaron Valdivia, Corresponding Secretary and Faculty Sponsor

New Initiates - Christian A. Colon Berly, Christopher James Brower, Triantafilos James Iakovidis, Virginia Machado, and Wiresh C. Punarasi.

GA Beta – Georgia College & State University

Corresponding Secretary – Rodica Cazacu; 5 New Members

New Initiates - Kristen Busby, Monica Pescitelli, Jonathan Self, Alaina Totten, and Lindsay Yates.

HI Alpha – Hawai'i Pacific University

Chapter President – Matt Troglia; 10 Current Members; 2 New Members

Other Fall 2013 Officers: Collin Paran, Vice President and Tara Davis, Corresponding Secretary and Faculty Sponsor

We had an initiation dinner, and we invited Dr. Lori Chibnik from Harvard to visit our university and give a talk in our Science Pub event as well as host an open forum. We also hosted an event (joint with STEM club) inviting a representative from career services to come talk with our students about graduate school applications.

New Initiates - Jontevius Johnson and Julian Dallas Cecil.

IA Alpha – University of Northern Iowa

Chapter President – Elizabeth Johnson; 35 Current Members; 5 New Members

Other Fall 2013 Officers: Travis Buhrow, Vice President; Ben Castle, Secretary; Paige Hageman, Treasurer; and Mark D. Ecker, Corresponding Secretary and Faculty Sponsor

Our first fall KME meeting was held on October 3, 2013 at Professor Mark Ecker's house where student member Elizabeth Johnson presented two proofs entitled "The Diagonals of a Rhombus Must Cross" and "The Midline Theorem for Triangles." Student member Paige Hageman presented her geometry proof at our second meeting on November 12, 2013 at Professor Syed Kirmani's home. Student member Travis Buhrow addressed the fall initiation banquet with "Has the NFL Moved from a Rushing League to a Passing League?" Our fall banquet was held at The Other Place Restaurant in Cedar Falls on December 10, 2013, where five new members were initiated.

New Initiates - Emily Bisenius, Kristin Koser, Luke Peterson, Leah Schoenberg, and Parash Upreti.

IA Delta – Wartburg College

Corresponding Secretary – Dr. Brian Birgen; 10 New Members

New Initiates - Benjamin Bogard, Nick Clasen, Jacob Geer, Kayla Elizabeth Hemann,

Alexander Jenson, Ryan Lindner Kemp, Ngan Le, Kayla Polson, Kellie Solberg, and Steven Douglas Zahn.

IA Epsilon – Central College

Corresponding Secretary – Dr. Russell Goodman

New Initiates - Ashley Cliff, Shannon Coulson, Josh Forst, Dr. Russ Goodman, Brian Hadley, Ashley Hulsing, Kayla Johnson, Tim Kahl, Melissa Ketcham, Kathy Manternach, Megan Miller, Hayley Noll, Katie Todd, and Dr. Wendy Weber.

IL Beta – Eastern Illinois University

Corresponding Secretary – Nancy Van Cleave; 37 New Members

New Initiates - Daniel Bergfeld, Joel Blome, Adam Bryant, Marli Choate, Bryan A. Crouch, Kyle Davis, Amy Deters, Anastasia Deters, Kayla Dowell, Sarah Drummond, Katherine English, Sarah Ethington, Jason Haarmann, Joshua Hawkins, Mallory Hittinger, Andrew Iffert, Olivia Klaus, Kaitlyn Kulek, Mary Larson, Sean McNamara, Bridget Mischke, Melissa Oakley, Amy Robertson, Marika Rosenberger, Jedediah Shumaker, Ravi Somayajulu, Ethan Swanson, Ryan Tripp, Anthony Trobaugh, Matthew J. Urfer, Jenette Vogt, Lester Wang, Alicia Wittenberg, Brian Wood, Caleb Worsham, Amanda Yingst, and David Zoerb.

IL Zeta – Dominican University

Chapter Co-Presidents – Lisa Gullo and Willa Skeehan; 35 Current Members; 6 New Members

Other Fall 2013 Officers: Yan Yan Chan, Secretary; Azucena Bahena, Treasurer; and Aliza Steurer and Aaron Zerhusen, Corresponding Secretaries and Faculty Sponsors

The Illinois Zeta Chapter of KME operates together with Dominican University's Math Club. Together, they held regular meetings this fall and hosted two talks. One talk was by Dr. Paul Coe on solving Rubik's cubes, and one was a panel discussion by current students on research and internship opportunities at Dominican. An initiation ceremony will be held in the spring.

New Initiates - Nikita Belyaev, Yanyan Chen, Karolina Kir, Arley Lopez, Kelvin Tiongson, and Samantha Traczyk.

KS Beta– Emporia State University

Chapter President – Brandon Marshall; 28 Current Members; 36 New Members

Other Fall 2013 Officers: Rachel Schomacker, Vice President; Russ Hinshaw, Secretary and Treasurer; Mike Mosier, Corresponding Secretary; and Dr. Kevin Charlwood, Faculty Sponsor

New Initiates - Abby Black, Devan Boeger, Tyler Boulware, Amy Bretches, Jianlei Chen, Kaylan Colgin, Sophia Crossen, Yinhao Du, Aly Dunlap, Ethan Francis, Jeff Hall, Kira Hall, Nichole Harper, Hayder Hashim, Liz Haverkamp, Norikatsu Hiraide, T.J. Huettenmueller, Madison Hunter, Zhiynan Jia, Yuan Jiang, Seulki Kim; Ziwei Li, Xiaotong Li,

Dylan Meeker, Michael Murrell, K. Kyunge un Park, Adam Petz, Rachel Peterson, Nicole Reutzel, Christine Shade, Xinran Shao; Jason Suptic, Peyton Wingert, Enok Woo, Jietong Zhang, and Jingwen Zhou.

KS Delta – Washburn University
Corresponding Secretary – Michael Mosier; 6 New Members

New Initiates - Branden Childers, Paige Eslick, Matthew Nicholas Herrman, Corey Alan Stevens, Paul Thurbon, and Jonathan A. Tyler.

KY Alpha – Eastern Kentucky University
Chapter President – Rebecca Thiem; 12 Current Members
Other Fall 2013 Officers: Ryan Whaley, Vice President; Seidina Conley, Secretary; Cory Clem, Treasurer; Pat Costello, Corresponding Secretary and Faculty Sponsor
The first meeting was an election of officers and a description of possible activities for the semester and year. The second meeting was a Sudoku competition with Blakeley England finishing the puzzle in record time. During the last week of the semester, we had a White Elephant Christmas Party with some nice gifts being exchanged. During the course of the semester, several students worked on problems from *The Pentagon*.

KY Beta – University of Cumberlands
Chapter President – Deborah Wilkerson; 18 Current Members
Other Fall 2013 Officers: Hannah Spangler, Vice President; Terra Baker, Secretary; Matthew Maher, Treasurer; Dr. Jonathan Ramey, Corresponding Secretary and Faculty Sponsor
Along with the Mathematics and Physics Club and Sigma Pi Sigma, the chapter had a picnic at Briar Creek Park on September 19. On December 13, the entire department, including the Kentucky Beta chapter, had a Christmas party with about 25 people in attendance.

MA Beta – Stonehill College
Chapter President – Katherine Osgood; 17 Current Members; 6 New Members
Other Fall 2013 Officers: Andrea Monterotti, Vice President; Timothy Woodcock, Corresponding Secretary and Faculty Sponsor
Massachusetts Beta rounded out the fall semester by sponsoring a math-major pizza party to mark the last week of classes. Lots of good food, mathematical camaraderie and conversation were enjoyed by all that attended. During the final-exam period, the student members of our chapter volunteered to staff a number of drop-by help sessions, open to all students preparing for final exams in calculus.

New Initiates - Kraig Boates, Jeanette Hogan, Mei-Lin McCarthy, Molly Neubauer, Ryan

Sullivan, and Sarah Wilson.

MD Beta – McDaniel College

Corresponding Secretary – Spencer Hamblen; 9 New Members

New Initiates - Olivia Brundage, Danielle Cloney, Lindsay Heckle, Thao Vy Ngo, Khanh Nguyen, Margaret Protzman, David Ruth, Benjamin Steinhurst, and Brian Theis.

MD Delta – Frostburg State University

Chapter President – Chris Colwander; 28 Current Members; 8 New Members

Other Fall 2013 Officers: Jen Scudder, Vice President; Nick Torgerson, Secretary; Meghan Voelkel, Treasurer; Mark Hughes, Corresponding Secretary and Faculty Sponsor; and Frank Barnet and Justin Dunmyre, Faculty Sponsors

The Maryland Delta Chapter had its first meeting in September. Featured was a presentation by the Math Department's newest faculty member Dr. Justin Dunmyre. Dr. Dunmyre, who also serves as a KME faculty sponsor, gave an interesting lecture concerning his research in Mathematical Biology. Specifically, the topic was on using differential equations to model neuron behavior. Our October meeting was devoted to watching some mathematics related videos. November was a busy month with the Chapter's participation in the University's annual Major's Fair and a successful bake sale. Our last meeting was held in December with a fascinating lecture by faculty sponsor Dr. Frank Barnet on Bitcoins. Finally, we offer congratulations to graduating members Jen Scudder, who served as Vice President, and Meghan Voelkel our Secretary.

New Initiates - Sara Ansteatt, Olivia Elisio, David Foerster, Jennifer Kleponis, Justus Peterson, Jocelyn Williams, Adam Witmer-Bosley, and Yonatan Estifanos.

MD Epsilon – Stevenson University

Chapter President – Harriet Adutwum; 33 Current Members; 13 New Members

Other Fall 2013 Officers: Hassan Zaheer, Vice President; Rebecca Wong, Secretary; David Allison, Treasurer; and Dr. Christopher E. Barat, Corresponding Secretary and Faculty Sponsor

On November 5, 2013, eight students, four faculty members, and one staff member were initiated into the Chapter. The guest speaker, 2011 initiate and Stevenson applied math graduate Charles Schuster of General Dynamics Information Technology, gave a presentation on "Why Math Should Be Your Best Friend."

New Initiates - David Allison, Mark Branson, Kaitlyn Carbaugh, Sean Dougherty, Erica Gryctz, Will Hodge, Dixie Hoyle, Patricia Law, Neal Miller, Ellen Roskes, Tierney Sugrue,

Erin Wolfe, and Hassan Zaheer.

MI Beta – Central Michigan University

Corresponding Secretary – Sivaram K. Narayan; 6 New Members

New Initiates - Elliot Brown, Leah Mays, Brady Tyburski, Nicole Feinauer, William Persall, and Kyle Manthei.

MI Delta – Hillsdale College

Chapter President – Abigail Loxton; 37 Current Members; 14 New Members

Other Fall 2013 Officers: Matthew Raffin, Vice President; Arena Govier, Secretary; Joshua Mirth, Treasurer; and Dr. David Murphy, Corresponding Secretary and Faculty Sponsor

During the fall 2013 semester, we had a fall picnic at the college's cross country course with current members and newly eligible students who will be initiated this spring.

New Initiates - Joel West Calvert, Cayley Cruickshank, Travis Homan, Thomas H. Rupp, Daniel Josiah Slonim, Andrew van der Harst, Grace VanLaanen, Ashley Wright, Alexis Haley, Lucas J. Hamelink, Matthew J. Hastreiter, Sarah Kreuz, Kadeem Noray and Sarah Jane Onken.

MO Alpha – Missouri State University

Chapter President – Rebecca Wood; 34 Current Members, 13 New Members

Other Fall 2013 Officers: Rachel Siemen, Vice President; Julie Barnum, Secretary; Marissa Mullen, Treasurer; and Jorge Rebaza, Corresponding Secretary and Faculty Sponsor

As every semester, we had three seminars. Seminar 1 was Wednesday, September 25, 2013 with Dr. Matthew Pierson, faculty member in the engineering program at MSU, talking about "Computer Modeling of Discrete Particles as Homogeneous Masses," and about careers in engineering. Seminar 2 was Thursday, October 17, 2013 with Dr. Saibal Mitra from the Physics Department at MSU talking about "Science, Pathological Science and Pseudoscience." During this seminar we also initiated 13 new KME members. Seminar 3 was Tuesday, November 19, 2013 with two students from the Senior Seminar class (MTH 497) presenting their papers: "The Chromatic Polynomial of the Complete K-Partite Graph," by Rebecca Wood, and "Emma Noether," by Rachel Siemen. Pizza and soda were served at each seminar. As in every fall semester, we organized a picnic on Thursday, September12, starting at 5:00 p.m. at Phelps Grove Park. As usual, we had a great turnout! We also had an end-of-semester party on Thursday, December 5 the last day of classes. We had lots of games music, food, drinks, and desserts. The secret Santa gift exchange was a great

success.

New Initiates - Justin Bancroft, Dylan Beck, Kelly Cope, Shannon Dulz, David Everman, Alexandra Gambino, Daniel Jones, Kyuhwan Jung, Meagan Leppien, Lauren Lewandowski, Michelle Pellegrino, Benjamin Svoboda, and Mena Whalen.

MO Beta – University of Central Missouri

Chapter President – LeighAnn Sherfey; 25 Current Members, 12 New Members

Other Fall 2013 Officers: Alex Card, Vice President; Tifini Gast, Secretary; Thomas Yoder, Treasurer; Amos Bailey, Historian; Rhonda McKee, Corresponding Secretary and Faculty Sponsor; and Steve Shattuck and Dale Bachman, Faculty Sponsors

Missouri Beta chapter celebrated its 75th Anniversary with a reunion on October 11-12, 2013. The reunion started with an informal social at the Achuer House on Friday evening. It is worth noting that the KME reunion was the first alumni event ever held in the newly acquired Achuer House. Saturday events included a morning run/walk, tailgating, a football game, and an evening banquet. After the banquet, alumnae Brittney Hinds gave a math talk titled When Zombies Attack: A Mathematical Model. Prizes were awarded for the member in attendance with the lowest chapter number and the highest chapter number. About 50 people, including alumni, current students, and faculty attended the reunion. Everyone enjoyed making connections to fellow Missouri Beta chapter members.

New Initiates - Amos Bailey Joshua Bounds, Aaron Butz, Benjamin D. Feine, Kevin Graumenz II, Samantha Heddinger, Lindsey Kirkweg, Rosalee Knipp, Bradley Jacob Orell, Alyssa Rinehart, Jackson Smith, and Madison Ultican.

MO Epsilon – Central Methodist University

Corresponding Secretary – Pam Gordy; 8 New Members

New Initiates - Brett A Davis, Kelsey Leigh Beeler, Andrew Buchanan, Jordan L. Erisman, Stetson Phillips, Samuel Pollock, Alexandra Nicole Surgeon, and Julia Elizabeth Weber.

MO Eta – Truman State University

Corresponding Secretary – David Garth; 7 New Members

New Initiates - Alora Bauer, Teresa Boschert, Evan Datz, Carnahan Lovewell, Katherine Maxwell, Matthew Short, and Christopher To.

MO Theta – Evangel University

Chapter President –Hope Moorhead; 12 Current Members; 7 New Members

Other Fall 2013 Officers: David Adams, Vice President; and Don Tosh, Corresponding Secretary and Faculty Sponsor

Meetings were held monthly. In October, we held an Ice Cream Social at the home of Don Tosh. We also welcomed a new mathematics faculty member Dianne Twigger. Dianne was a former student at Evangel and a

member of KME since 2005.

New Initiates - Alexis Geurink, Megan Hallmark, Kaitlyn Hong, Elizabeth Nauert, Jonnie Opfer, Bethany VanderMolen, and Shyara Wickramaratne.

MO Iota – Missouri Southern State University

Corresponding Secretary – Charles Curtis; 16 New Members

New Initiates - Haley Hendrix, Ethan Honeycutt, Courtney Hooper, JeTaime Hovis, Jesse Khopang, Shemaiah Khopang, Michael Lowe, Stephanie Meyer, Maxwell Murphy, Kristina Pritchard, Danielle Severns, David Sigars, Brett Simkins, Benjamin Starkey, Andrew Stokes, and Jordan Stoner.

MO Nu – Columbia College

Corresponding Secretary – Dr. Kenny Felts; 8 New Members

New Initiates - Levi Elder, Matthew Glindemann, Quinten Koldan, Briana Nodine, Ujjwal Pandey, Mikey Thomas, Tiffany Urwiler, and Mark Vaughn.

MS Alpha – Mississippi University for Women

Corresponding Secretary – Joshua Hanes; 1 New Member

New Initiate - Britny Sarver.

MS Delta – William Carey University

Corresponding Secretary – Charlotte McShea; 37 New Members

New Initiates - Marcia Adamo, Lauren Anderson, Kayleigh Anspach, Shelby Barrett, William Buchanan, Jacob Chapman, Aaron Crowley, Miles Deaton, Tyler Eggers, Ashten Elerson, Fernando Garcia, Abigail Good, Dev Gurung, Joannie Harrell, Melissa Hays, Bailee Hickman, Isaac Hitt, Dominik Kardell, Sean Laird, Cassandra Lasher, Madeline LeBoeuf, Hannah Martin, Brennan McDaniel, Stella McIver, Jonathan Morris, Chante Musgrove, Damilola Olagunju, Bibhusha Pradhan, Nistha Pradhan, Tyree Ratcliff; Tiffany Roberts, Nikesh Man Singh, Stephen Stanford, John Edward Sullivan; Caitlin Urton, Randy Wright, and Simpson Whitfield.

MS Epsilon – Delta State University

Corresponding Secretary – Paula Norris; 4 New Members

New Initiates - Liza Cope, Morgan Maloney, Megan Mayfield, and Elisabetta Zengaro.

NC Epsilon – North Carolina Wesleyan College

Corresponding Secretary – Bill Yankosky; 3 New Members

New Initiates - Megan Brabble, Jasmine Danae' Edgren, and Jason Sean Riley.

NC Eta – John C. Smith University

Corresponding Secretary – Brian Hunt; 13 New Members

New Initiates - Jamaris Burns, Christopher Cornwall, Zanier Fuller, Stephen Gilmore, Samantha Goba, Clayton Gordon, Briana Howard, Eliu Iraheta, Shaketa Jones, LaBrina McRae, Jamar Robinson, Kevon Scott, and Rodrigo Vazquez.

NE Beta – University of Nebraska Kearney

Chapter President – Nathan Brady; 11 Current Members; 3 New Members

Other Fall 2013 Officers: Chevy Smith, Vice President; Kayla McMahon, Secretary; Stephanie Rudder, Treasurer; and Dr. Katherine Kime, Corre-

sponding Secretary and Faculty Sponsor

We continue to develop a list of possible speakers. Dr. Kime suggested considering individuals who were Math majors as undergrads and had perhaps unexpected career paths.

New Initiates – Lindsey Pearson, Grace Synek, and Andrea Vargas.

NE Delta – Nebraska Wesleyan University

Chapter President – Alex Whigham; 9 Current Members

Other Fall 2013 Officers: Jayme Prenosil, Vice President; Leanne Hinrichs, Secretary and Treasurer; and Melissa Erdmann, Corresponding Secretary and Faculty Sponsor

This semester we enjoyed numerous combined events with the computer science and physics clubs, including a fall picnic and a holiday party. We also had a game night, an internship/REU panel composed of current students, and a first-ever fun problem solving evening.

NJ Delta – Centenary College of New Jersey

Corresponding Secretary and Faculty Sponsor – Kathy Turrisi

The Delta New Jersey Chapter met for meetings at the Downtown Centenary location during the evening where we had movie night, pizza night, and even celebrated birthdays with a large ice cream cake. We discussed the option of starting an Associate membership for our Delta Chapter where the "teacher of" students could become involved and it was unanimously decided we would initiate these students locally in the Spring 2014. Students continue to tutor at the Mathematics Tutoring Center (MTC) at the Downtown Centenary location for free. The MTC offers math tutoring free for grades 2 through 6 and high school. An initiation ceremony/award ceremony is planned for April 28.

NY Lambda – LIU Post

Chapter President – Yiran Zhang; 25 Current Members; 16 New Members

Other Fall 2013 Officers: Michelle DiDomenico, Vice President; Elyse Capozza, Secretary; Eda Kuscakoglu, Treasurer; and Dr. James B. Peters, Corresponding Secretary and Faculty Sponsor

NY Nu – Hartwick College

Chapter President – Nathan Nichols; 15 Current Members

Other Fall 2013 Officers: Jessica Bentley, Vice President; Aaron Parisi, Secretary; Kyle Murray, Treasurer; and Ron Brzenk, Corresponding Secretary and Faculty Sponsor

NY Omicron – St. Joseph's College

Chapter President – Stephen Bates; 22 Current Members; 31 New Members

Other Fall 2013 Officers: Janéce Guerra, Vice President; Daniel Ferguson, Secretary; Carl Baurle, Treasurer; Dr. Elana Reiser, Corresponding

Secretary; and Dr. Donna Marie Pirich, Faculty Sponsor

This semester the NY Omicron chapter continued to serve our community by volunteering to tutor local high school students in our math clinic. We also held a fundraiser that allowed us to buy Christmas toys to donate for children of mothers who were victims of domestic violence, and who are now homeless.

New Initiates - Jessica Lynn Alessi, Anthony Averso, Michael J. Balestrieri, Thomas J. Bergin, Liny Chan, Lauren Conter, Nicole A. Danisi, Christopher M. DeSimone, Jessica D. Dragos, LauraLynne Duffy, Lynn Rose Gustie, Jaclyn Kennedy, John B. LaRock, Jolene Leonardo, Kristen Licari, Victoria LoBosco, Thomas R. Matthews, Shulin Mei, Joseph Mendez, Stephen C. Opacke, Alexander D. Ras, Franky Rodriguez, John Savarese, Andrew Solberg, Matthew R. Stitt, Emma F. Tapada, John M. Tymeck, Emmanuel Uwadiegwu, Flora Uwadiegwu, James T. Young, and Michael Zwosta.

NY Pi – Mount Saint Mary College

Corresponding Secretary – Lee Fothergill; 9 New Members

New Initiates - Cassandra M. Behre, Christine Brown, Amanda A. Harden, Troy M. Mahon, Matthew Milone, Toni A. Navarro, Caitlin Elizabeth Piperato, Samuel Watson, and Kailyn P. Zanella.

NY Rho – Molloy College

Corresponding Secretary – Dr. Manyiu Tse; 15 New Members

New Initiates - Christy Babst, Nicole Bernard, Monica Campagna, Sarah Ewald, Erica Joseph, Kevin Kempski, Dane Leavy, Mary-Kate Michels, Samantha Novak, Craig Padgett, Maria Pulella, Samantha Sauer, Victoria Sorrentino, Brianna Tortorelli, and Santiago Vargas.

OH Alpha – Bowling Green State University

Chapter President – Steve Siuda; 3 New Members

Other Fall 2013 Officers: Rob Kelvey, Vice President; Mark Medwid, Secretary; Amy Wolf, Treasurer; Steven Seubert, Corresponding Secretary; and Jim Albert, Faculty Sponsor

New Initiates - Mike Hughes, John Maddrey, and Mark Medwid.

OH Gamma – Baldwin Wallace University

Corresponding Secretary – Dr. David Calvis; 21 New Members

New Initiates - Brooke J. Adkins, Sean R. Anderson, Bridgette N. Bowers, Erin E. Bryant, Elizabeth C. Cherry, Ashley S. Demeter, Maria Cristina Dorsey, Gregory M. Fesz, Thomas Iverson, Heather R. Knotts, Christopher W. Moore, Daniela F. Muhaj, Paul E. Nerlich, Marina J. Ojaimi, Samuel M. Schwab, Audrey L. Smolik, Tate M. Stoll, Samuel G. Vanni, Whitney R. Yoder, Kaylee M. Yuhas, and Stevan Zlojutro.

OH Epsilon – Marietta College

Chapter President – Misty Hussing; 20 Current Members

Other Fall 2013 Officers: Jacob Double, Vice President; and John Tynan,

Corresponding Secretary and Faculty Sponsor

OH Zeta – Muskingum University

Corresponding Secretary – Richard Daquila; 12 New Members

New Initiates - Ferdinand Avila-Soto, Fernando Avila-Soto, Lyle Cowgill, Jill Crone, Nathan Duff, Kyle Finnell, Timothy Fries, Jennifer Hastings, Phillip Krall, Sarah Linn, Kelly Martin, and Joshua Rogoff.

OH Eta – Ohio Northern University

Corresponding Secretary – Donald Hunt; 9 New Members

New Initiates - Tyler John Bernardy, Alec J. Flemming, Josh Gedert, Tyler O. Germann, Joshue Hille, Nathan Knodel, Michael Vernon Potter, David Patrick Reeping, and Sarah Renea Zinn.

OK Alpha – Northeastern State University

Chapter President – JeAnna Philpot; 49 Current Members, 13 New Members

Other Fall 2013 Officers: Caleb Stubbs, Vice President; Steven Sly, Secretary; James Townsend, Treasurer; and Dr. Joan E. Bell, Corresponding Secretary and Faculty Sponsor

Our fall initiation brought eight new members into our chapter. At our meetings found solutions to several problems in The Pentagon. We sold honor cords to KMS members who graduated fall 2013. The last meeting of the year was planned to be a joint meeting with the Physics Club, but was postponed until spring due to snow and ice.

New Initiates - Cherokee Anderson, Hudson Q. Baab, JoAnna Billips, Brooke T. Bratu, Jacob D. Cook, Micheal R. Crockett, Whitney R. Dushane, Tommy D. Gonzales Sr., Karmyn P. Grigson, Margaret Horner, Cindy Jeffcoat, Briana Ketcher, Lauren Lowe-Thompson, Luther J. Langston II, Julia A. Markle, John P. Moore II, Andrea R. Morgan, Haylee C. Phillips, Demitri J. Plessas, Allan Porras-Romero, and Farah Toler.

PA Beta – La Salle University

Chapter President – Dominick Macaluso; 20 New Members

Other Fall 2013 Officers: David Comberiate, Vice President; Olivia Shoemaker, Secretary; Daniel Bowers, Treasurer; and Dr. Stephen Andrilli, Corresponding Secretary and Faculty Sponsor

During Fall 2013, the KME Student Chapter (aka the Math Association) of La Salle University (PA Beta Chapter) sponsored a talk by Dr. Richard Laverty, an applied mathematician at the Boeing Company in Ridley Park, PA. Two students in the chapter began weekly visits to a local elementary school (St. Athanasius School in Philadelphia) to provide exciting enrichment activities for some of that school's strongest mathematics students. Finally, the formal planning began for the upcoming initiation of 20 new student members of KME in Spring, 2014.

New Initiates - Austin Anderson, Alicia Aughton, Caitlyn Baker, Katherine Boligitz, Adam

Callaghan, Kelly Collins, Carmen Esposito, Noemi Gonzalez-Arvisu, James Petrino, Kaitlyn Petruccelli, Timothy Presser, Renat Roytenberg, Candice Schumann, Matthew Simpson, Lindsey Stasiorowski, Thearra Su, Michael Trodden, Brittany Truskowski, Christine Vollrath, and Mary-Elizabeth Voss.

PA Theta – Susquehanna University

Corresponding Secretary – Kenneth Brakke; 10 New Members

New Initiates - Kristy Anderson, Brittany Fell, Nathan Fox, Ran Li, Steven Lipkowitz, Bryan Palsi, Samantha Rodriguez, Stephanie Schneider, Catherine Tomkiel, and Joseph Villari.

PA Iota – Shippensburg University

Chapter President – Allen Koederitz; 741 Current Members; 7 New Members

Other Fall 2013 Officers: Grant Innerst, Vice President; Lindsey Schadler, Secretary; Maria Markovich, Treasurer; Dr. Paul Taylor, Corresponding Secretary, and Dr. Ji Young Choi, Faculty Sponsor

We have recently moved to having initiation in Spring only, so Fall 2013 was a quiet semester.

New Initiates - Jeffrey Andrews, Grant Innerst, Allen Koederitz, Maria Markovich, Colin Plank, Lindsey Schadler, and Brandon Thrush.

PA Kappa – Holy Family University

Chapter President – Rebecca Gaetani; 4 Current Members

Other Fall 2013 Officer: Sr. Marcella Wallowicz, CSFN, Corresponding Secretary and Faculty Sponsor

New Initiates - Arielle Brady, Jared DeLeo, and Brandon Schaeffer.

PA Lambda – Bloomsburg University of Pennsylvania

Corresponding Secretary – Elizabeth Mauch; 20 New Members

New Initiates - Brittany Albertson, Michael Ashton, Tom Brannan, Cynthia Catapano, Landan Cheruka, Katerina Custis, Annya D'Amato, Matt Gift, Thyme Greenfield, Celia Hudon, Paige Kavanaugh, Katrina Merz, Megan Naughton, Robert Riley, Emily Sandt, Collin Shoop, Sarah Stover, Jonathan Thomas, Xinying Xu, and Amanda Yanek.

PA Mu – Saint Francis University

Chapter President – Sean Veights; 37 Current Members; 20 New Members
Other Fall 2013 Officers: Elise Löfgren, Vice President; Ryan Ickes, Secretary; Maggie Waldron, Treasurer; Dr. Peter Skoner, Corresponding Secretary; and Dr. Katherine Remillard, Faculty Sponsor

KME members held a problem solving gathering on September 19 in the new Science Center. Dr. Brendon LaBuz joined the student officers and other members of pizza, drinks, and problems.

New Initiates - Kelly Beegle, Chelsea Crandall, Andrea Felski, Cathleen Fry, Brouk Gebreab, Matthew Julian, Kevin Kraus, Andrew Litzinger, Dalton Mack, Cristina Marcillo, Dallas Mosier, Amaris Rodriguez, Travis Schofield, William Shee, Taylor Spangler, Kelly

Walde, Kaitlyn Waldron, David Wolfe, Matthew Wong, and Sarah Yeager.

PA Xi – Cedar Crest College

Corresponding Secretary – Marie Wilde; 6 New Members

New Initiates - Lindsey Burke, Jasmeen Kaur, Melanie Schade, Alyssa Schoenberger, Angela Snyder, and Amanda Walck.

PA Rho – Thiel College

Corresponding Secretary – Max Shellenbarger; 11 New Members

New Initiates - Anna Hart, Emily Howard, Kathleen Kent, Tanner Liptrap, June Longbine, Mary Oakey, Derek Runge, Kelsey Schneider, John Tenorio, Kayla Welty, and Michelle Wimer.

PA Tau – DeSales University

Chapter President – Angela M. Ulrich; 11 New Members

Other Fall 2013 Officers: Zachary Sikanowicz, Vice President; Jaquelin M. Pastor, Secretary; Keith T. Crozier, Treasurer; and Br. Daniel P. Wisniewski, O.S.F.S., Corresponding Secretary and Faculty Sponsor

RI Beta – Bryant University

Chapter President – James Wood; 27 Current Members

Other Fall 2013 Officers: Andrew DiFronzo, Vice President; Delaney Carr, Secretary; Summer Lyons, Treasurer; John Quinn, Corresponding Secretary; and Alan Olinsky, Faculty Sponsor

Our board met twice this fall to discuss the creation of chapter by-laws and the planning of the chapter initiation for new members in the spring. The by-laws have now been completed with the standards for eligibility for Bryant students to become members of KME. The application for new members will be sent out early during the spring semester. There was also some discussion about sending a couple of students to the National Convention in Alabama in April, subject to locating available funding from both Bryant University and KME.

SC Delta – Erskine College

Chapter President – Kelly Walker; 9 Current Members

Other Fall 2013 Officers: Paris Hanvey, Vice President; Rachel Whitmire, Treasurer; Dr. A. Gorka, Faculty Sponsor and Corresponding Secretary

The SC Delta chapter held monthly join meetings with the Krazy Math Enthusiasts Math Club and organized a few successful events and activities, of which the biggest was a Pi Day fundraiser. It included stations with games and puzzles, pie a professor, buy pies, raffle, and info booth.

SC Epsilon – Francis Marion University

Corresponding Secretary – Damon Scott; 11 New Members

New Initiates - Jeremiah Bartz, Julian Buck, Lucía Cataldo-Ottieri, John Keith Gathings Jr., D. Quinton Gray, Steven Larry Jackson Jr., Christian Todd Rhodes, Scott Randall Scruggs,

Ezekiel Shuler, Aaron K. Smith, and Julie Stone.

SD Beta – Black Hills State University

Chapter President – Rachel Solano

Other Fall 2013 Officers: Zachary Zenk, Vice President; Kelsey Dalzell, Secretary; Keenan Justice, Treasurer; Kristel Ehrhardt, Corresponding Secretary; and Dr. Hui Mai, Faculty Sponsor

TN Alpha – Tennessee Technological University

Corresponding Secretary – Andrew Hetzel; 20 New Members

New Initiates - John Ash, Derek Babb, Tabitha Clark, Jonathan Ellis, Anthony Emiren, Samantha Fletcher, Mary Forde, Benjamin Griffith, Jay Howard, Jonathan Kell, Philip Kilmon, Habeeb Kotun, Brendan Laney, Joshua Moffett, Jacob Parsley, Joseph Simpson, Hayley Stowell, Corbin Tucker, Siwei Wang, and David Williams.

TN Zeta – Lee University

Chapter President – Brittany Kanerva; 8 Current Members; 26 New Members

Other Fall 2013 Officers: Katherine Defer, Vice President; Lindsay Holdman, Secretary; Anna Sandberg, Treasurer; Blayne E. Carroll Sr., Corresponding Secretary; and Caroline Maher-Boulis, Faculty Sponsor

New Initiates - Dr. Caroline Maher-Boulis, Elizabeth Bower, Benjamin Buckner, Anna M. Clay, Sarah Alexandra Dawe, Katherine Defer, Hollie Marie German, Julie A. Hardesty, Lindsay Holdamn, Sarah Johnson, Brittany Kanerva, Maria Medrano, Charles Meystrik, Dr. L. Jeneva Moseley, Latishua Overton, Mesa Pracht, Nicholas B. Ramsey, Sharise Riether, Anna Sandberg, Tyler Smith, Erica Swindle, Kara Smith, Casey Taylor, Lauren Todd, Briana Yankie, and Michael Odell Yokosuk.

TX Alpha – Texas Tech University

Corresponding Secretary – Magdalena Toda; 5 New Members

New Initiates - Amelia Cox, Mary Eden De La Garza, Alexandra Kipple, Gregory McKinney, and Annabel Offer.

TX Mu – Schreiner University

Corresponding Secretary – Stefan Mecay; 17 New Members

New Initiates - Fernando Albiter, Kim Arvidsson, Logan M. Brinkley, Veronica Castillo, Samuel D. Chadwick, Aaron Chatagnier, Ben Troy Enslow, Austin H. Fine, Ben William Garrett, Kaitlyn Marie Goertz, Daniel T. Ketterer, Trevor Richard Mara, Emily McAllister, Josh Ramirez, Jennifer Lynn Scozzari, Michael Anthony Stewart II, and Ian David Taulli.

VA Delta – Marymount University

Chapter President – Myriam Joga; 32; Current Members

Other Fall 2013 Officers: William Heuett, Corresponding Secretary; and Elsa Schaefer, Faculty Sponsor

WI Gamma – University of Wisconsin-Eau Claire

Chapter President – Michael Loper; 5 New Members

Other Fall 2013 Officers: Cassandra Dale, Secretary; Rosie Ricci, Trea-

surer; and Dr. Carolyn Otto, Corresponding Secretary and Faculty Sponsor

New Initiates - Alexander Brown, Linh Dao, Derek Levin, Roseanne Ricci, and Victoria Wenner.

Active Chapters of Kappa Mu Epsilon

Listed by date of installation

Chapter	Location	Installation Date
OK Alpha	Northeastern State University, Tahlequah	18 Apr 1931
IA Alpha	University of Northern Iowa, Cedar Falls	27 May 1931
KS Alpha	Pittsburg State University, Pittsburg	30 Jan 1932
MO Alpha	Missouri State University, Springfield	20 May 1932
MS Alpha	Mississippi University for Women, Columbus	30 May 1932
MS Beta	Mississippi State University, Mississippi State	14 Dec 1932
NE Alpha	Wayne State College, Wayne	17 Jan 1933
KS Beta	Emporia State University, Emporia	12 May 1934
AL Alpha	Athens State University, Athens	5 Mar 1935
NM Alpha	University of New Mexico, Albuquerque	28 Mar 1935
IL Beta	Eastern Illinois University, Charleston	11 Apr 1935
AL Beta	University of North Alabama, Florence	20 May 1935
AL Gamma	University of Montevallo, Montevallo	24 Apr 1937
OH Alpha	Bowling Green State University, Bowling Green	24 Apr 1937
MI Alpha	Albion College, Albion	29 May 1937
MO Beta	University of Central Missouri, Warrensburg	10 Jun 1938
TX Alpha	Texas Tech University, Lubbock	10 May 1940
KS Gamma	Benedictine College, Atchison	26 May 1940
IA Beta	Drake University, Des Moines	27 May 1940
TN Alpha	Tennessee Technological University, Cookeville	5 Jun 1941
MI Beta	Central Michigan University, Mount Pleasant	25 Apr 1942
NJ Beta	Montclair State University, Upper Montclair	21 Apr 1944
IL Delta	University of St. Francis, Joliet	21 May 1945
KS Delta	Washburn University, Topeka	29 Mar 1947
MO Gamma	William Jewell College, Liberty	7 May 1947
TX Gamma	Texas Woman's University, Denton	7 May 1947
WI Alpha	Mount Mary College, Milwaukee	11 May 1947
OH Gamma	Baldwin-Wallace College, Berea	6 Jun 1947
CO Alpha	Colorado State University, Fort Collins	16 May 1948
MO Epsilon	Central Methodist College, Fayette	18 May 1949
MS Gamma	University of Southern Mississippi, Hattiesburg	21 May 1949
IN Alpha	Manchester College, North Manchester	16 May 1950
PA Alpha	Westminster College, New Wilmington	17 May 1950
IN Beta	Butler University, Indianapolis	16 May 1952
KS Epsilon	Fort Hays State University, Hays	6 Dec 1952
PA Beta	LaSalle University, Philadelphia	19 May 1953
VA Alpha	Virginia State University, Petersburg	29 Jan 1955
IN Gamma	Anderson University, Anderson	5 Apr 1957
CA Gamma	California Polytechnic State University, San Luis Obispo	23 May 1958
TN Beta	East Tennessee State University, Johnson City	22 May 1959
PA Gamma	Waynesburg College, Waynesburg	23 May 1959
VA Beta	Radford University, Radford	12 Nov 1959
NE Beta	University of Nebraska—Kearney, Kearney	11 Dec 1959
IN Delta	University of Evansville, Evansville	27 May 1960

OH Epsilon	Marietta College, Marietta	29 Oct 1960
MO Zeta	University of Missouri—Rolla, Rolla	19 May 1961
NE Gamma	Chadron State College, Chadron	19 May 1962
MD Alpha	College of Notre Dame of Maryland, Baltimore	22 May 1963
CA Delta	California State Polytechnic University, Pomona	5 Nov 1964
PA Delta	Marywood University, Scranton	8 Nov 1964
PA Epsilon	Kutztown University of Pennsylvania, Kutztown	3 Apr 1965
AL Epsilon	Huntingdon College, Montgomery	15 Apr 1965
PA Zeta	Indiana University of Pennsylvania, Indiana	6 May 1965
AR Alpha	Arkansas State University, Jonesboro	21 May 1965
TN Gamma	Union University, Jackson	24 May 1965
WI Beta	University of Wisconsin—River Falls, River Falls	25 May 1965
IA Gamma	Morningside College, Sioux City	25 May 1965
MD Beta	McDaniel College, Westminster	30 May 1965
IL Zeta	Dominican University, River Forest	26 Feb 1967
SC Beta	South Carolina State College, Orangeburg	6 May 1967
PA Eta	Grove City College, Grove City	13 May 1967
NY Eta	Niagara University, Niagara University	18 May 1968
MA Alpha	Assumption College, Worcester	19 Nov 1968
MO Eta	Truman State University, Kirksville	7 Dec 1968
IL Eta	Western Illinois University, Macomb	9 May 1969
OH Zeta	Muskingum College, New Concord	17 May 1969
PA Theta	Susquehanna University, Selinsgrove	26 May 1969
PA Iota	Shippensburg University of Pennsylvania, Shippensburg	1 Nov 1969
MS Delta	William Carey College, Hattiesburg	17 Dec 1970
MO Theta	Evangel University, Springfield	12 Jan 1971
PA Kappa	Holy Family College, Philadelphia	23 Jan 1971
CO Beta	Colorado School of Mines, Golden	4 Mar 1971
KY Alpha	Eastern Kentucky University, Richmond	27 Mar 1971
TN Delta	Carson-Newman College, Jefferson City	15 May 1971
NY Iota	Wagner College, Staten Island	19 May 1971
SC Gamma	Winthrop University, Rock Hill	3 Nov 1972
IA Delta	Wartburg College, Waverly	6 Apr 1973
PA Lambda	Bloomsburg University of Pennsylvania, Bloomsburg	17 Oct 1973
OK Gamma	Southwestern Oklahoma State University, Weatherford	1 May 1973
NY Kappa	Pace University, New York	24 Apr 1974
TX Eta	Hardin-Simmons University, Abilene	3 May 1975
MO Iota	Missouri Southern State University, Joplin	8 May 1975
GA Alpha	State University of West Georgia, Carrollton	21 May 1975
WV Alpha	Bethany College, Bethany	21 May 1975
FL Beta	Florida Southern College, Lakeland	31 Oct 1976
WI Gamma	University of Wisconsin—Eau Claire, Eau Claire	4 Feb 1978
MD Delta	Frostburg State University, Frostburg	17 Sep 1978
IL Theta	Benedictine University, Lisle	18 May 1979
PA Mu	St. Francis University, Loretto	14 Sep 1979
AL Zeta	Birmingham-Southern College, Birmingham	18 Feb 1981
CT Beta	Eastern Connecticut State University, Willimantic	2 May 1981
NY Lambda	C.W. Post Campus of Long Island University, Brookville	2 May 1983
MO Kappa	Drury University, Springfield	30 Nov 1984
CO Gamma	Fort Lewis College, Durango	29 Mar 1985

NE Delta	Nebraska Wesleyan University, Lincoln	18 Apr 1986
TX Iota	McMurry University, Abilene	25 Apr 1987
PA Nu	Ursinus College, Collegeville	28 Apr 1987
VA Gamma	Liberty University, Lynchburg	30 Apr 1987
NY Mu	St. Thomas Aquinas College, Sparkill	14 May 1987
OH Eta	Ohio Northern University, Ada	15 Dec 1987
OK Delta	Oral Roberts University, Tulsa	10 Apr 1990
CO Delta	Mesa State College, Grand Junction	27 Apr 1990
PA Xi	Cedar Crest College, Allentown	30 Oct 1990
MO Lambda	Missouri Western State College, St. Joseph	10 Feb 1991
TX Kappa	University of Mary Hardin-Baylor, Belton	21 Feb 1991
SC Delta	Erskine College, Due West	28 Apr 1991
SD Alpha	Northern State University, Aberdeen	3 May 1992
NY Nu	Hartwick College, Oneonta	14 May 1992
NH Alpha	Keene State College, Keene	16 Feb 1993
LA Gamma	Northwestern State University, Natchitoches	24 Mar 1993
KY Beta	Cumberland College, Williamsburg	3 May 1993
MS Epsilon	Delta State University, Cleveland	19 Nov 1994
PA Omicron	University of Pittsburgh at Johnstown, Johnstown	10 Apr 1997
MI Delta	Hillsdale College, Hillsdale	30 Apr 1997
MI Epsilon	Kettering University, Flint	28 Mar 1998
KS Zeta	Southwestern College, Winfield	14 Apr 1998
TN Epsilon	Bethel College, McKenzie	16 Apr 1998
MO Mu	Harris-Stowe College, St. Louis	25 Apr 1998
GA Beta	Georgia College and State University, Milledgeville	25 Apr 1998
AL Eta	University of West Alabama, Livingston	4 May 1998
NY Xi	Buffalo State College, Buffalo	12 May 1998
NC Delta	High Point University, High Point	24 Mar 1999
PA Pi	Slippery Rock University, Slippery Rock	19 Apr 1999
TX Lambda	Trinity University, San Antonio	22 Nov 1999
GA Gamma	Piedmont College, Demorest	7 Apr 2000
LA Delta	University of Louisiana, Monroe	11 Feb 2001
GA Delta	Berry College, Mount Berry	21 Apr 2001
TX Mu	Schreiner University, Kerrville	28 Apr 2001
NJ Gamma	Monmouth University, West Long Branch	21 Apr 2002
CA Epsilon	California Baptist University, Riverside	21 Apr 2003
PA Rho	Thiel College, Greenville	13 Feb 2004
VA Delta	Marymount University, Arlington	26 Mar 2004
NY Omicron	St. Joseph's College, Patchogue	1 May 2004
IL Iota	Lewis University, Romeoville	26 Feb 2005
WV Beta	Wheeling Jesuit University, Wheeling	11 Mar 2005
SC Epsilon	Francis Marion University, Florence	18 Mar 2005
PA Sigma	Lycoming College, Williamsport	1 Apr 2005
MO Nu	Columbia College, Columbia	29 Apr 2005
MD Epsilon	Stevenson University, Stevenson	3 Dec 2005
NJ Delta	Centenary College, Hackettstown	1 Dec 2006
NY Pi	Mount Saint Mary College, Newburgh	20 Mar 2007
OK Epsilon	Oklahoma Christian University, Oklahoma City	20 Apr 2007
HA Alpha	Hawaii Pacific University, Waipahu	22 Oct 2007
NC Epsilon	North Carolina Wesleyan College, Rocky Mount	24 Mar 2008

CA Zeta	Simpson University, Redding	4 Apr 2009
NY Rho	Molloy College, Rockville Center	21 Apr 2009
NC Zeta	Catawba College, Salisbury	17 Sep 2009
RI Alpha	Roger Williams University, Bristol	13 Nov 2009
NJ Epsilon	New Jersey City University, Jersey City	22 Feb 2010
NC Eta	Johnson C. Smith University, Charlotte	18 Mar 2010
AL Theta	Jacksonville State University, Jacksonville	29 Mar 2010
GA Epsilon	Wesleyan College, Macon	30 Mar 2010
FL Gamma	Southeastern University, Lakeland	31 Mar 2010
MA Beta	Stonehill College, Easton	8 Apr 2011
AR Beta	Henderson State University, Arkadelphia	10 Oct 2011
PA Tau	DeSales University, Center Valley	29 Apr 2012
TN Zeta	Lee University, Cleveland	5 Nov 2012
RI Beta	Bryant University, Smithfield	3 Apr 2013
SD Beta	Black Hills State University, Spearfish	20 Sept 2013