Introduction to Tuberculosis

- Endemic infectious disease that attacks the lungs
- Airborne
- Latently infected or infectious
- Weak immune systems more likely to develop active TB
- Cured by antibiotics in 6-12 months
- Drug-resistant strains
- "Slow" disease
- Evidence for TB transmission through close contacts
Preliminaries

We have used the Heaviside function:

\[
H(t) = \begin{cases} 
1 & t \geq 0 \\
0 & t < 0
\end{cases}
\]

We now define one of the Heaviside waves of the form:

\[
H(t) = \begin{cases} 
1 & t \geq 0 \\
0 & t < 0
\end{cases}
\]
Costa Rican Jaguars

- The jaguar is an apex and keystone species.
- The jaguar is generally considered an umbrella species.

Figure: Panthera Onca
Effects of Migration on Population Dynamics

(a) Patch One

(b) Patch Two

Figure: Connected Patches with $K_{L2} = 0.8K_{L1}$

Costa Rican Jaguar Population Dynamics
Modeling of Master and Slave Oscillators in Birds during Migratory Season

Tom Montgomery and Lisa Caughey
Overview of Problem

In order to approximate the roots of a univariate trinomial over the complex numbers, can we get a tight bound on the difference between its roots and the roots of its binomials?
Problem of Cooperation from a Game Theoretic Perspective

An individual, self-interested actor; there is a prima facie contradiction between the actor's self-interest and cooperating with another actor at any cost. Classical game-theoretic interaction predicts that egoistic actors would avoid behaviors that would reduce their own gain without consideration of the well-being of others, seeing only to maximize their own gain.

A problem interesting to...

This work is viewed as an evolutionary theory and public policy study the evolution of behavior. Although each field is given to assess the question from different angles, there is a universal appeal of the question of cooperation to many evolutionary investigators.

The most popular tool used to investigate the aspect of cooperation (i.e., whether I spent all my time this summer wondering...)

Euler's Okun's game
Major Players in Development:

- Hemangioblasts
  - Pluripotent cell type
- Vascular Endothelial Growth Factor (VEGF)
  - Chemotactic organizer
- FLK-1 Receptor
  - VEGF receptor
Future Directions

- Problems with carrying capacity
- Incorporate node movement
diagonal
- stronger effective capabilities
- 3-D model
Constraints

- No interval may contain 0, and there must be at least one interval on each side of 0.
- By symmetry, let \( W = [-a, -b) \cup [c, d) \cup [e, f) \), where \(-a < -b < 0 < c < d < e < f\).
- To tile \( \mathbb{R} \setminus \{0\} \) over scaling, we need that

\[
\begin{align*}
    a &= 2b \\
    \frac{df}{ce} &= 2 \\
    e &= 2^k d, k \in \mathbb{Z}^2 \\
    \Rightarrow f &= 2^{k+1} c
\end{align*}
\]
Definition 2. An interval $[a, b]$ is a subset of $I$ such that for any $A \subseteq I$ there exists a countable set $W$ so that $W \cap I = A$.
Recall from circuits, Ohm’s law:

\[ I = \frac{V}{R} \]

Where \( I \) is current, \( V \) is the voltage (electric force), and \( R \) is resistance.

Analogously, in the circulatory system:

\[ Q = \frac{\Delta P}{R} \]

Where \( Q \) is flow, \( \Delta P \) is the change in pressure, \( R \) is resistance.

\[ Q = \frac{\pi r^4 \Delta P}{8 \mu L} \cdot \frac{1}{R} \Delta P \]
When is a Schauder basis also a frame?

Theorem
Let \( \{x_n\}_{n=1}^{\infty} \) be a Schauder basis of \( H \). The following are equivalent:

1. \( \{x_n\}_{n=1}^{\infty} \) is a frame.
2. \( \{x_n\}_{n=1}^{\infty} \) is a Flesz basis (i.e., there exists a bounded invertible linear operator \( T : H \rightarrow H \) such that \( Tc = x_0 \)).
3. \( \{x_n\}_{n=1}^{\infty} \) is seminormalized and unconditional.
Example (contd.)

Now, by Hölder's inequality we can estimate the third term in the previous inequality by

\[
\sum_{j=1}^{\infty} |a_j|^2 \leq \left( \sum_{j=1}^{\infty} |a_j|^2 \right) \left( \sum_{j=1}^{\infty} \sum_{i=1}^{\infty} \alpha_i^2 \right)
\]

\[
\leq \left( \sum_{j=1}^{\infty} |a_j|^2 \right) \left( \sum_{j=1}^{\infty} j \alpha_j^2 \right)
\]

and get \( |P_n(x)| \leq (1 + \sum_{j=1}^{\infty} j \alpha_j^2) |x|^2 \).

In the terms where one chooses \( P_n(x) \) and \( P_m(x) \) then set \( \alpha_n = \alpha_m = 0 \) and get

\[
|P_n(x)| \leq |P_m(x)|. \]
Graduate Program in Mathematics at Texas A&M University

A general overview (July 2007)
Applying the inverse kinematics problem to molecular modeling

To apply the inverse kinematics problem to molecular modeling we must make a few assumptions:

- Vision the molecular chain as a rigid structure where atoms are simply points in 3-space.
- Note that the conformational flexibility of a molecule is only due to the ability of its parts to rotate about the axes defined by the single covalent bond.
- Hermitian Matrix:
  - a square matrix with the property that the complex conjugate of $a_{ij}$ is $a_{ji}$.

- Positive Semidefinite Matrix
  - Hermitian
  - Nonnegative eigenvalues
  - Denoted $A \geq 0$