The Safety Net Problem: A Variation on Graph Theory’s Minimum Spanning Tree (MST) Algorithm
for NCUWM 2023

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1 Background

2 Our Problem

3 Two Approaches
   - MST-First
   - Path-First

4 Comparison

5 Current and Future Research
A graph, $G$, contains a set of, $E$, edges and $V$, vertices, i.e. $G = \{E, V\}$. 
Background: Nodes
Background: Edges
Background: Weights
Outline

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Problem: Minimum Spanning Tree (MST)

“Given a set of (point) terminals, connect them by a network of direct terminal-to-terminal links having the smallest possible total length (sum of the link lengths).”

- R. C. Prim
“Given a connected graph, $G$, with positive edge weights, find a minimum weight set of edges that connects all of the vertices.”

- GeeksforGeeks
Application Example
Application Example: MST

The Safety Net Problem
Additionally: How do we find the optimal path on graph, $G$, between required nodes, in the set $R$, such that if an edge is removed, the required nodes will remain connected?
Application Example: Paths
Application Example: Paths
Application Example: Paths

The Safety Net Problem
Application Example: Paths
Application Example: Paths
Application Example: Paths

The Safety Net Problem
Quick Note: Required Nodes

![Diagram of required nodes with numbers 1 to 10 labeled]

Wiest (Fresno State)
Outline

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5. Current and Future Research
MST-First Approach
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The Safety Net Problem
MST-First Approach
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Path-First Approach
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MST-First Safety Net
Original Weight: 245
Final Weight: 123
Path-First Safety Net
Original Weight: 245
Final Weight: 125
Outline

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Current and Future Research

- Reducing time complexity
- Continuing to compare the two approaches
- Making various adjustments to the algorithms
- Generalizing beyond grid graphs
- etc.
Thank you!
Any questions?
References


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