# Model Description for the Phase 2 Hurricane Recovery Problem

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## 1 Variable Glossary

### 1.1 Constants

- $C_{FlowI}$ is steady state flow on the grid before the hurricane
- $C_{lineIJ}$ is the capacity limit for the power line going from IJ
- $C_{RepairTimeI}$ is the time to repair node I
- $C_{TravelIJ}$ is the travel time between nodes I and J
- $C_{broken}$ is a coefficient of "broken-ness" representing the average slowdown from debris on the road and minor flooding

### 1.2 Variables

- $Z_i^t$ is the total power flow at node i at time t
- $X_{ij}^t$ is the flow from i to j at time t
- $Y_i^t$ is 1 if node i is functioning at time t
- $W_{ij}^t$ is 1 if line ij is functioning at time t
- $S_i^t$ is 1 if node i is serviced at time t
- $K_{ij}^t$ is 1 if node j follows node i in the tour at time t
- $F_i^t$ is 1 is node i is serviced at time t t

### 1.3 Sets

- L is the set of nodes
- P is the set of power lines
- R is the set of roads
- T is the planning horizon

## 2 Model

$$Minimize \sum_{i \in L} \sum_{t \in T} C_{FlowI} - Z_i^t$$

Subject to:

- $Z_i^t = (\sum_{j \in L} X_{ji}^t) Y_i^t \ \forall t \in T \ \forall i \in L$
- $\sum_{i \in L} X_{ik} = \sum_{j \in L} X_{kj} \ \forall t \in T \ \forall k \in L$
- $X_{ij}^t \leq C_{lineIJ} W_{ij}^t \ \forall t \in T \ \forall i, j \in P$
- $\sum_{i \in L} C_{RepairTimeI} F_i^t + \sum_{i \in L} \sum_{j < i \in L} K_{ij}^t C_{TravelIJ} C_{broken} \leq 8 \ \forall t \in T$
- $\sum_{j \in L} K_{0j}^t \geq 1$
- A subtour elimination constraint, though I'm not sure what the best way to set this up is

## 3 Comments

- The first constraint system is not linear, and I'm worried about it causing a mess of runtime.
- Does the lack of multiplication by functionality in the second constraint system mean that we could choose X values that are non-zero for a broken node?