

Plowing for a Cornell Crowd

Cornell Mathematical Contest in Modeling, 2025

7th November, 2025

Background

The City of Ithaca receives, on average, about 65 inches of snow each year. Storms can vary widely in timing, intensity, and temperature. The Department of Public Works (DPW) is responsible for maintaining approximately 65 miles of road (about 150 miles of lanes when including both directions and parking lanes) using truck-mounted plows and salt spreaders. Snow removal priorities place arterial roads, steep hills, and emergency access routes first, followed by smaller residential streets. In some neighborhoods, Odd/Even parking rules are temporarily enforced to allow plows to reach the curblane, especially in narrow streets.

Plowing typically happens in multiple passes: first clearing travel lanes to make them passable, then widening them and re-establishing parking lanes. Plows travel at about 25 mph. Salt is used to melt ice, but becomes ineffective below -6.7°C (20°F). Once snow has been compacted into ice by vehicle or pedestrian traffic, plows cannot remove it, and it must be melted or physically broken up. When storms arrive in rapid succession, or temperatures stay low for long periods, plows must often revisit the same areas multiple times, delaying work in others. Ithaca's policies on snow removal are [here](#).



The Challenge

A major 12-hour snowstorm is forecast to hit Ithaca, starting at 4am, on the same day as Cornell University's Winter Graduation. Visitors are expected from across the country, many unfamiliar with the local roads, and demand for parking near campus will be high. In addition to the city's normal priorities, DPW wants to ensure that campus roads and main access routes to Cornell are kept particularly clear during the event. At the same time, other parts of the city cannot be neglected, as emergency access and neighborhood safety remain top priorities.

Your task is to design a model and operational plan that captures the complexities of real-world snow removal. There are at most 12 plow drivers, though the city wants to use the minimum number of drivers in case there is more snow to come in the following days (driver's have hour restrictions).

Advise the City of Ithaca how best to use its snow plows. In developing your plan, you may want to think carefully about:

- **Network and geography.** The road network differs in width, steepness, traffic volume, and priority level. Some streets are arterial connectors; others are quiet residential roads. Steep grades may require more frequent treatment.

- **Event-driven priorities.** Certain routes, such as those from downtown hotels and parking areas to campus, may be more critical on this day. How should these be prioritized without causing unacceptable delays in other areas?
- **Service frequency.** Different priority levels imply different maximum allowable times between plow passes during snowfall (e.g., high-priority roads may require clearance every two hours). A long storm may require several passes before the snow even stops falling.
- **Parking rules and access.** Odd/Even parking rules can make a street accessible to plows one day but not the next. A single non-compliant vehicle can block clearance to the curblane.
- **Travel speed and time.** Snowfall rate, road grade, and lane count affect plow speeds and time needed per pass. Multi-lane roads may require multiple passes with narrower blades.
- **Salt use and weather dependence.** Salt supplies are finite and lose effectiveness in very cold conditions. Decisions about when and where to salt may depend on temperature trends and traffic levels.
- **Fairness and equity.** Service across neighborhoods can vary if resources are concentrated on high-priority or event-related routes. How can equitable access be maintained without compromising safety?
- **Robustness to disruption.** Breakdowns, delayed starts, or a second wave of snowfall may occur. Can the plan adapt without leaving large areas untreated?

Expectations

You may use any publicly available data, such as GIS road networks, traffic classifications, terrain information, historical weather data, and municipal policies. Your recommendation to the city should be simple enough to explain to the plow drivers and give them assignments. The plow drivers need to periodically restock with salt and take breaks in accordance with federal regulations.

The final write-up should explain the modeling assumptions, data sources, and decision logic, present a clear operational strategy, and evaluate its effectiveness, fairness, and robustness. A concise executive summary should convey your recommendations in a way that a city public-works director could act upon.