



University of Antwerp
Operations Research Group

ANT/OR

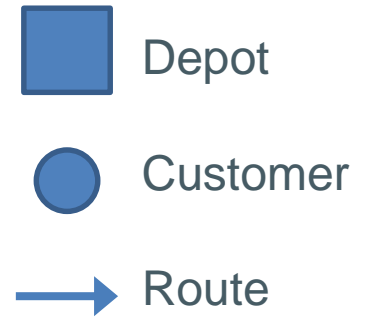
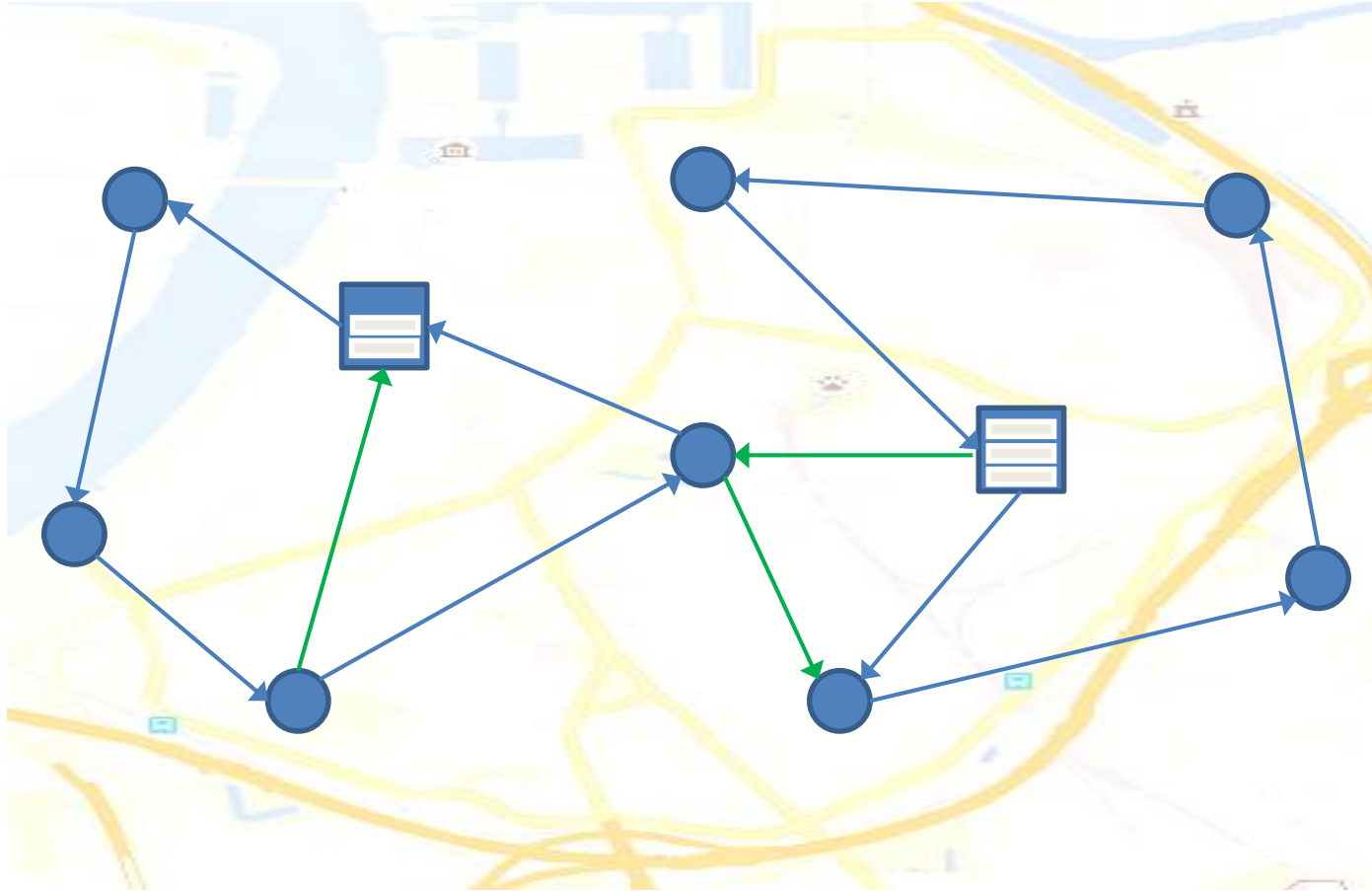
From storage to shipment

The effect of ignoring inventory when planning routes

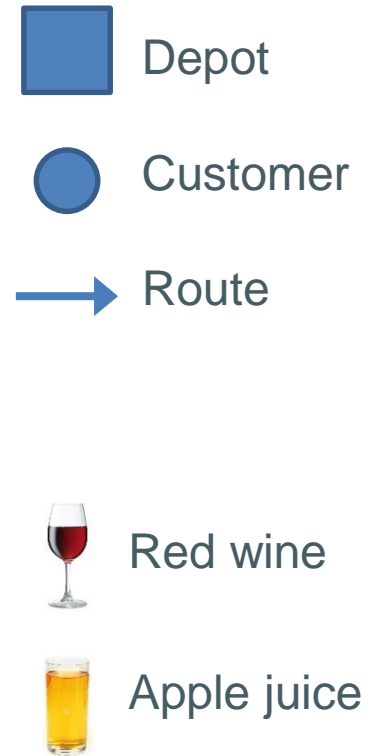
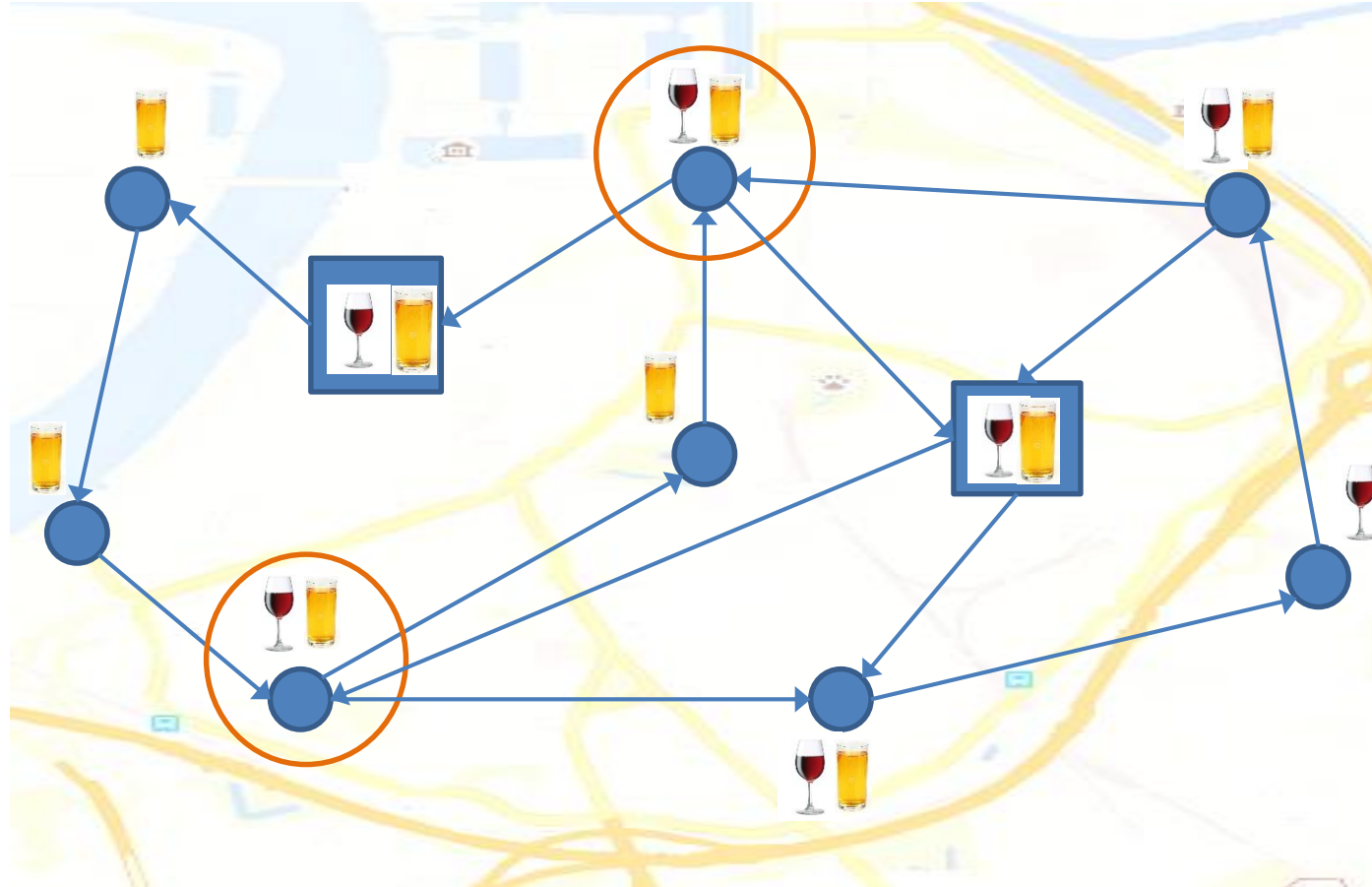
Florian Arnold

Doctoral Day, 30.11.2016

Inventory affects routing decisions

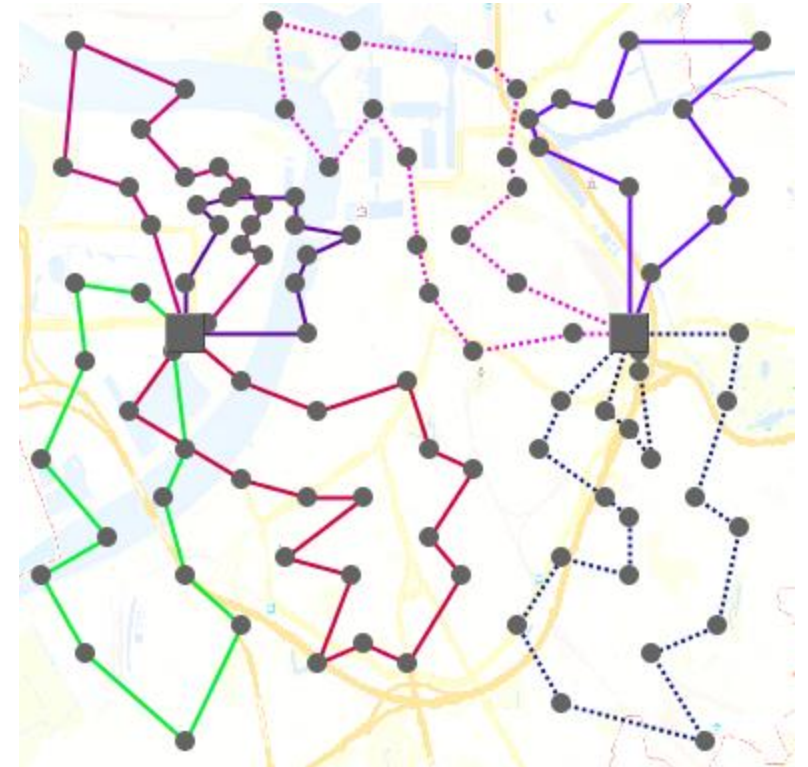


In reality, companies supply more than one (type of) product



Routing in reality

1. Inventory restricts routing
2. Multiple products are delivered and stored
3. Not all products might be stored in all depots

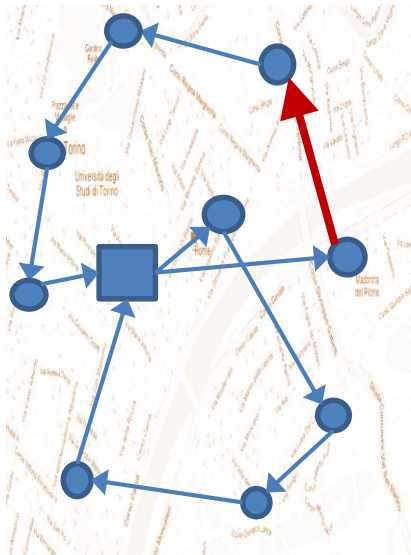


Contributions

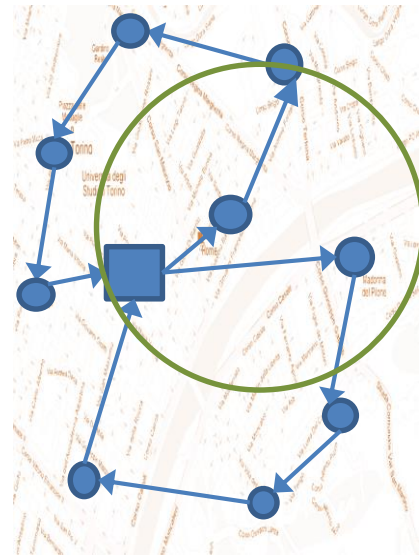
1. Develop a heuristic to compute solutions for inventory-restricted routing
2. Explore interdependencies between routing and inventory



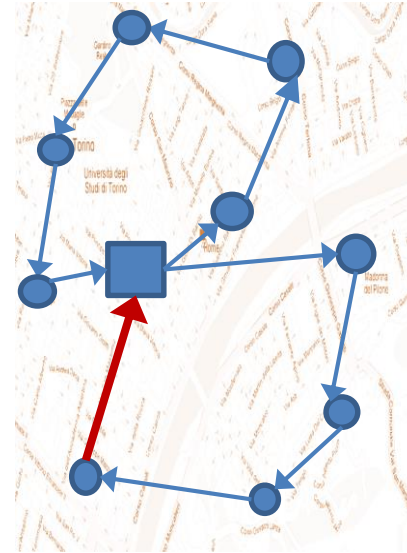
A general heuristic for routing problems



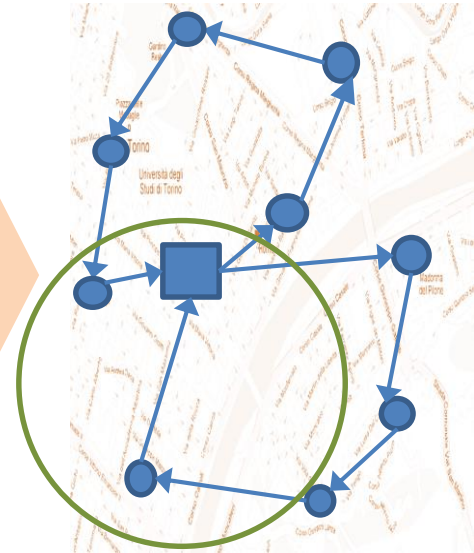
Penalize Edge



Local Search



Penalize Edge



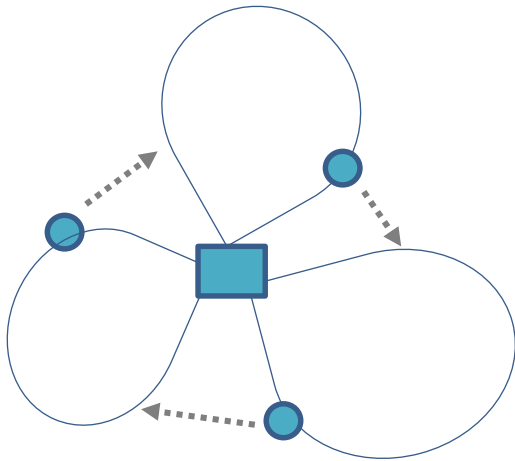
Local Search

...

Local Search operators

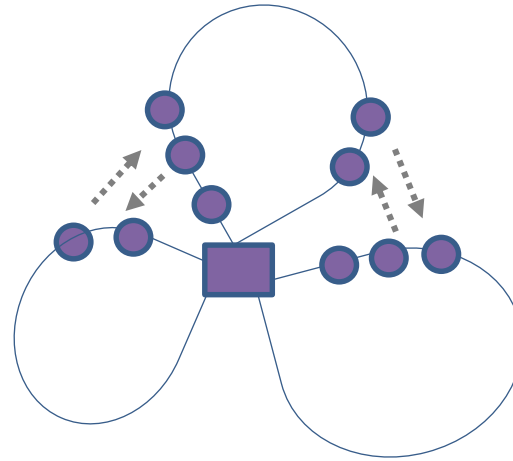
Ejection chain

Relocate Individual nodes



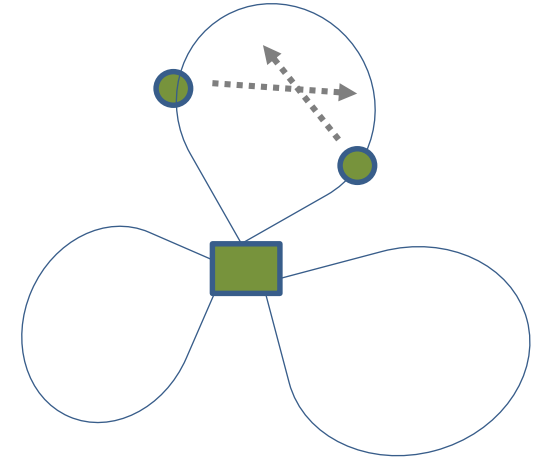
Multi-Swap (chain)

Relocate multiple nodes



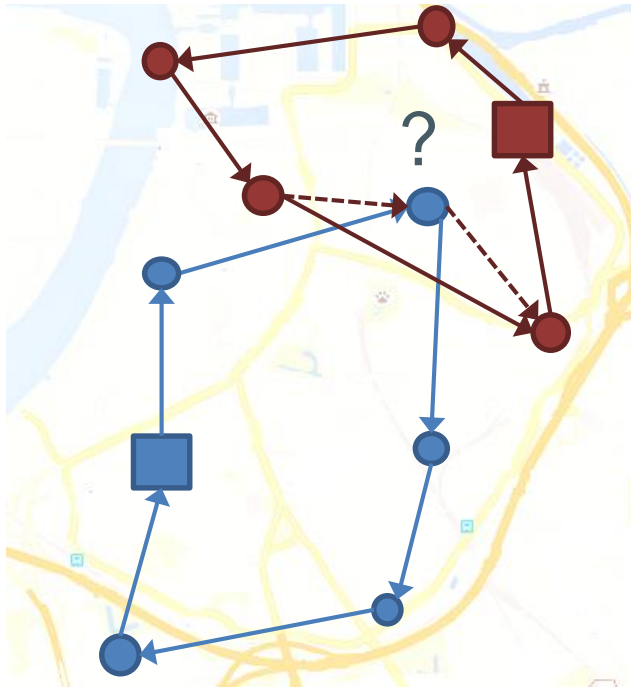
Lin-Kernighan

A Route is always optimal in itself

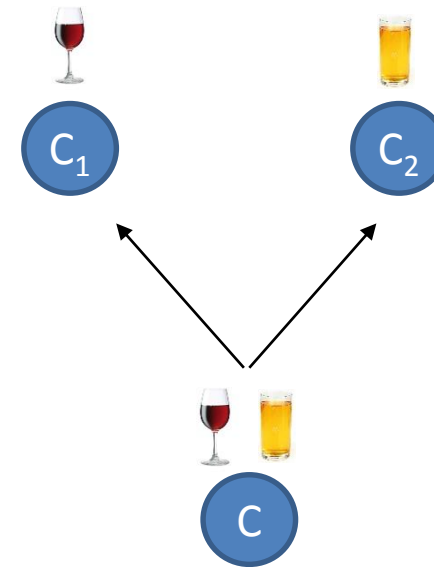


Including inventory constraints

Inter-depot changes need to fulfill inventory constraints

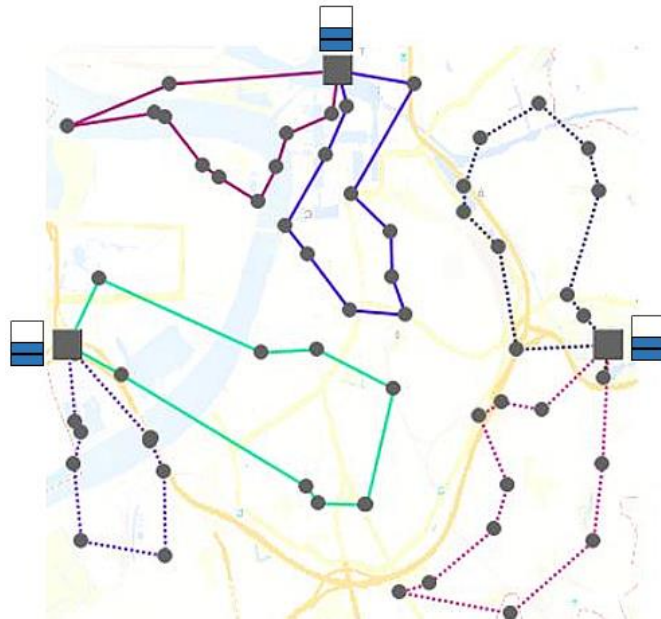


Customers with multiple demand are splitted

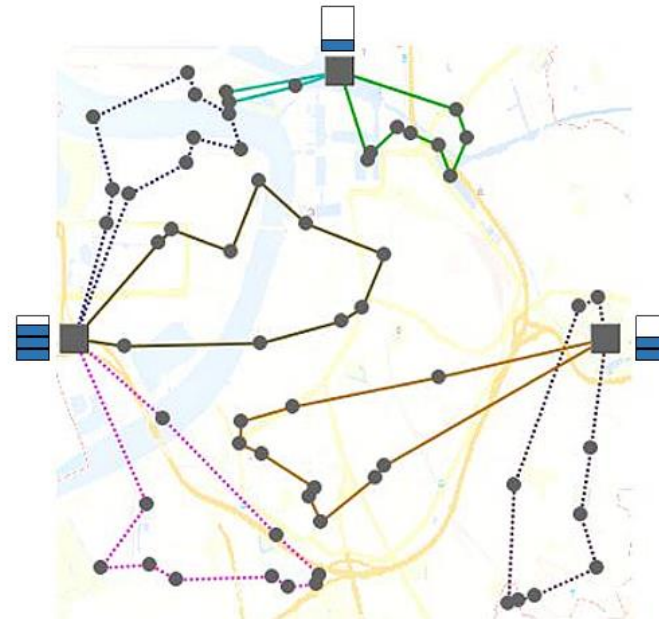


Inventory situations can be distinguished by

- Total amount of all inventory in all depots $D < I_{total} < 2D$
- The distribution of this amount among the depots *Equal, good, bad*

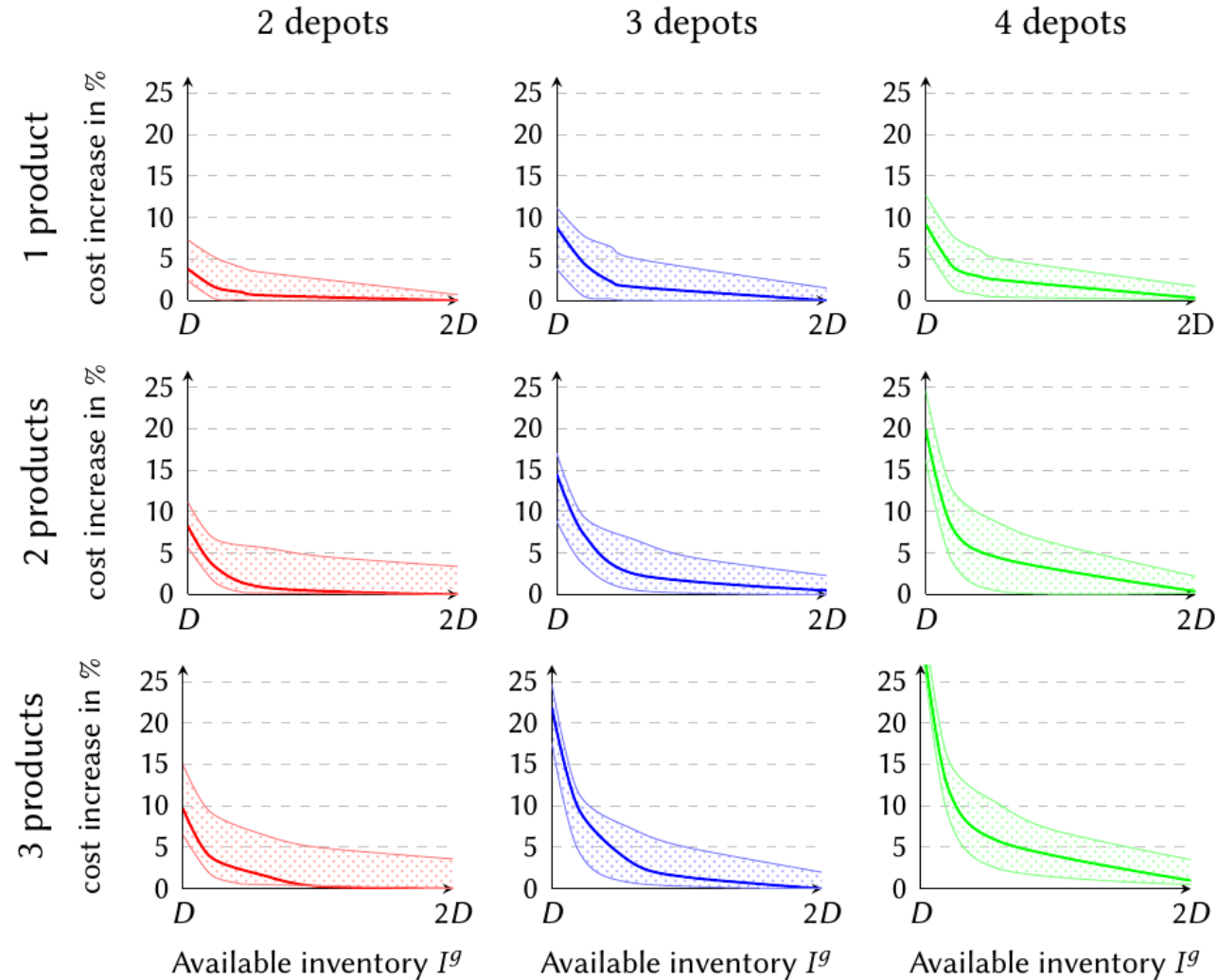


Equal distribution

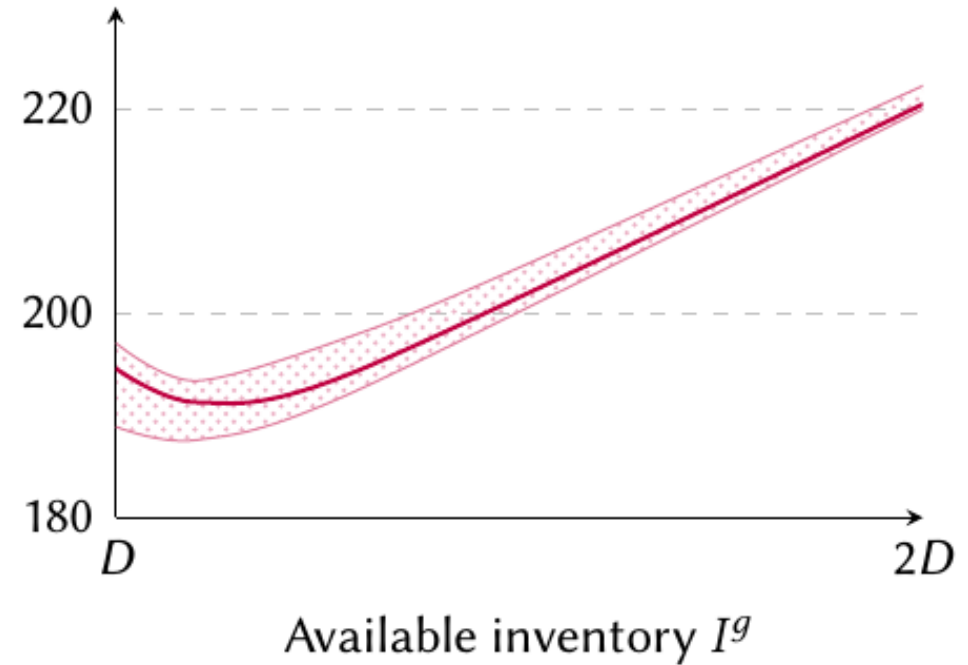
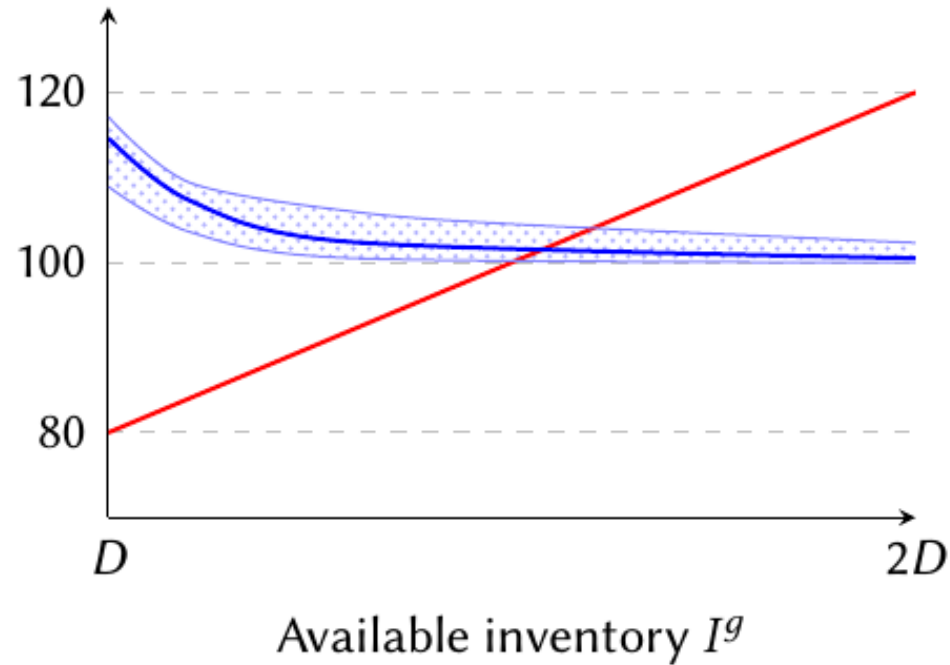


Bad distribution

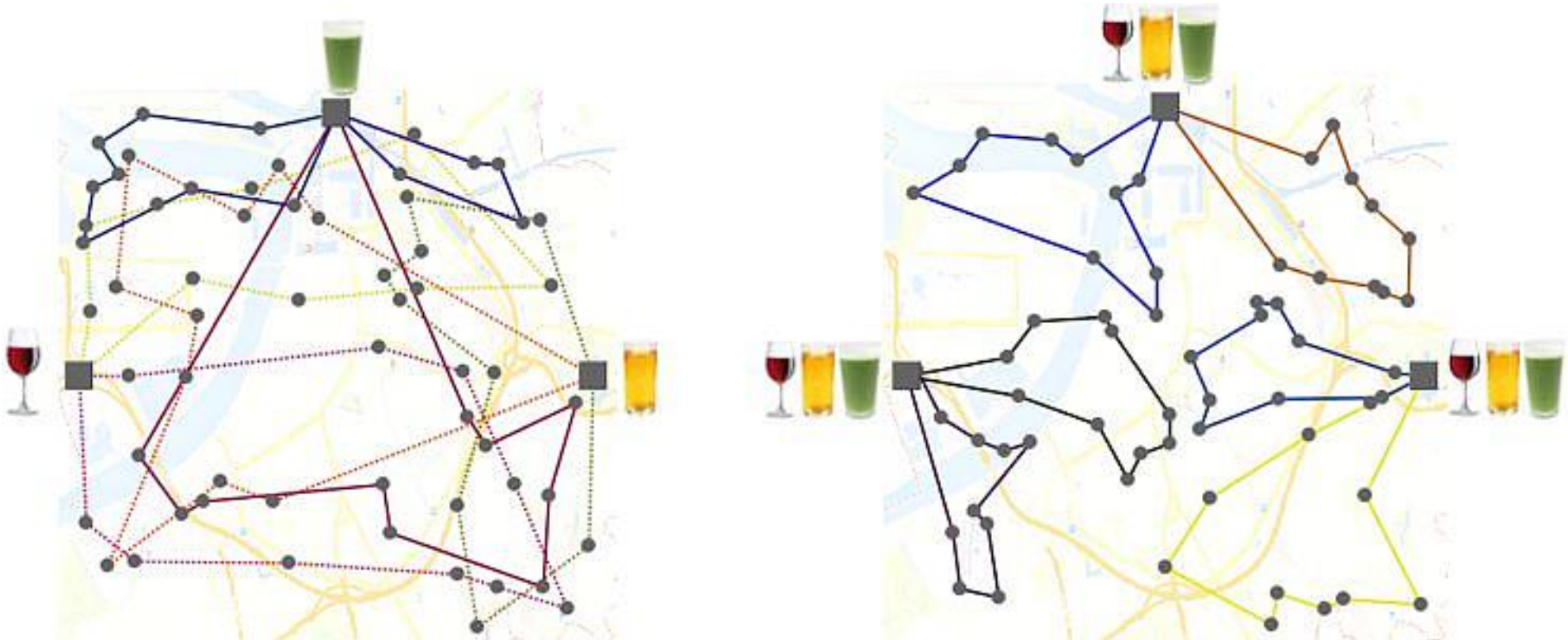
Effect of different inventory situations on routing costs



What does this mean for the combined cost of inventory holding and routing?

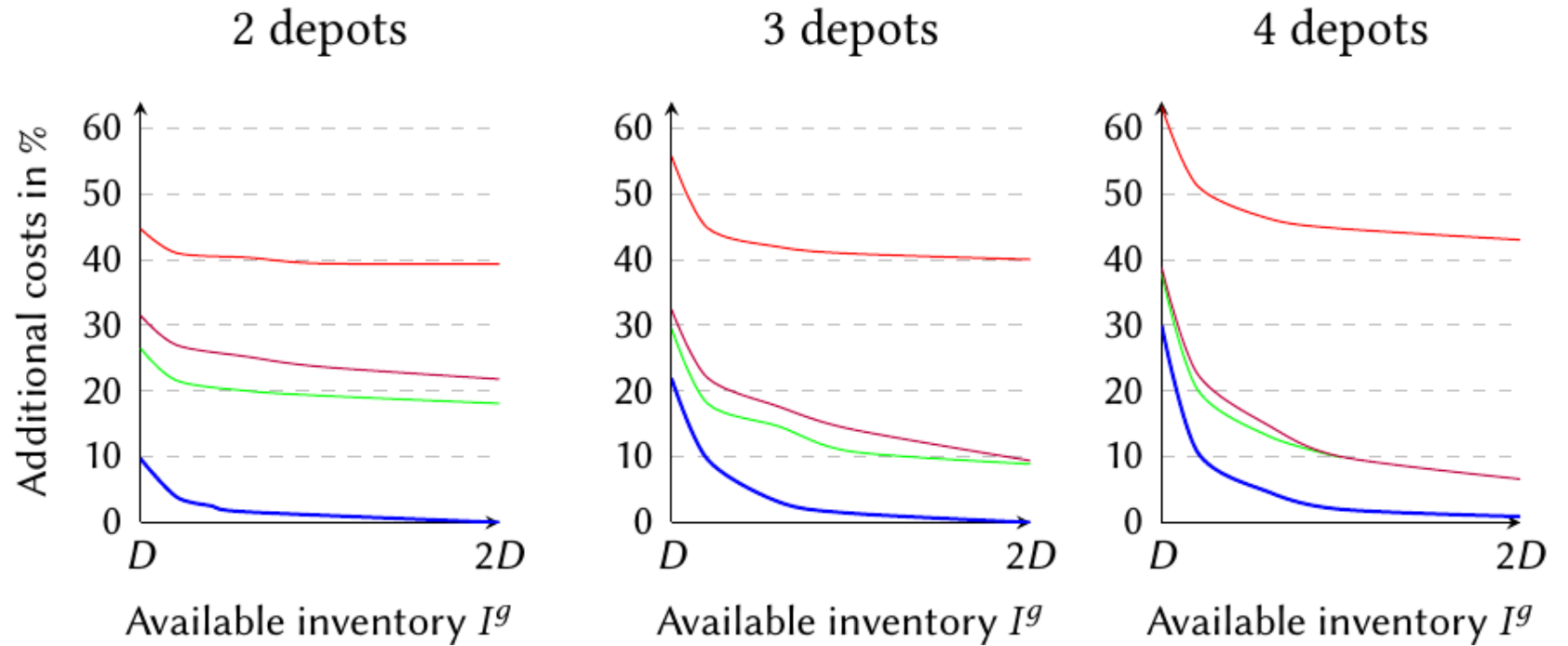


What happens, if not all products are stocked in all depots?



What happens, if not all products are stocked in all depots?

- 3 products per depot
- 1 depot missing 1 product
- 1 depot missing 2 products
- all depots missing 1 product



Take away

- ✓ Few inventory and/or a bad inventory allocation can increase routing costs by up to 30%
- ✓ If not all products are stocked in all depots, routing costs increase drastically by up to 60%
- ✓ There is a need to combine inventory and routing decisions

