

# A supply-driven inventory routing problem

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## Overview

We consider an inventory routing problem (IRP) in which routing and inventory replenishment decisions are dictated by supply rather than demand. This problem emanates from logistics related to biogas distribution in which biogas is transported in containers from many suppliers to a single facility using a single vehicle. We propose a novel and compact formulation for the supply-driven IRP that enables exact solving realistic instances. Furthermore, our model incorporates closed-loop distribution and bidirectional flows of containers. Each containers also acts as storage capacity at a supplier and holds continuous inventory contents. We perform computational experiments to derive insights on the behavior of optimal schedules.

## Methods

We employ a Mixed-Integer Linear Programming (MILP) approach.

## Results

No results have been obtained yet.

## Conclusions

No conclusions have been obtained yet.

## References

- Aghezzaf, El-Houssaine, Birger Raa, Hendrik Van Landeghem. 2006. Modeling inventory routing problems in supply chains of high consumption products. *European Journal of Operational Research* 169(3) 1048–1063.
- Anily, S., A. Federgruen. 1990. One warehouse multiple retailer systems with vehicle routing costs. *Management Science* 36(1) 92–114.
- Archetti, Claudia, Luca Bertazzi, Gilbert Laporte, Maria Grazia Speranza. 2007. A branch-and-cut algorithm for a vendor-managed inventory-routing problem. *Transportation Science* 41(3) 382–391. doi:10.1287/trsc.1060.0188.
- Avella, Pasquale, Maurizio Boccia, Antonio Sforza. 2004. Solving a fuel delivery problem by heuristic and exact approaches. *European Journal of Operational Research* 152(1) 170–179.
- Bard, Jonathan F., Liu Huang, Patrick Jaillet, Moshe Dror. 1998. A decomposition approach to the inventory routing problem with satellite facilities. *Transportation Science* 32(2) 189–203. doi:10.1287/trsc.32.2.189.

- Bell, Walter J., Louis M. Dalberto, Marshall L. Fisher, Arnold J. Greenfield, R. Jaikumar, Pradeep Kedia, Robert G. Mack, Paul J. Prutzman. 1983. Improving the distribution of industrial gases with an on-line computerized routing and scheduling optimizer. *Interfaces* 13(6) 4–23.
- Bertazzi, Luca, Giuseppe Paletta, M. Grazia Speranza. 2002. Deterministic order-up-to level policies in an inventory routing problem. *Transportation Science* 36(1) 119–132.
- Boudia, Mourad, Christian Prins. 2009. A memetic algorithm with dynamic population management for an integrated production–distribution problem. *European Journal of Operational Research* 195(3) 703–715.
- Campbell, Ann Melissa, Martin W. P. Savelsbergh. 2004. A decomposition approach for the inventory-routing problem. *Transportation Science* 38(4) 488–502. doi:10.1287/trsc.1030.0054.
- Chien, T. William, Anantaram Balakrishnan, Richard T. Wong. 1989. An integrated inventory allocation and vehicle routing problem. *Transportation Science* 23(2) 67–76.
- Chitsaz, Masoud, Ali Divsalar, Pieter Vansteenwegen. 2016. A two-phase algorithm for the cyclic inventory routing problem. *European Journal of Operational Research* 254(2) 410 – 426. doi:https://doi.org/10.1016/j.ejor.2016.03.056.
- Christiansen, Marielle. 1999. Decomposition of a combined inventory and time constrained ship routing problem. *Transportation science* 33(1) 3–16.
- Coelho, Leandro C., Jean-François Cordeau, Gilbert Laporte. 2014. Thirty years of inventory routing. *Transportation Science* 48(1) 1–19.
- Easwaran, Gopalakrishnan, Halit Uster. 2009. Tabu search and benders decomposition “ approaches for a capacitated closed-loop supply chain network design problem. *Transportation Science* 43(3) 301–320. doi:10.1287/trsc.1090.0267.
- Ekici, Ali, Okan Orsan “ Ozener, G“ultekin Kuyzu. 2015. Cyclic delivery schedules for an “ inventory routing problem. *Transportation Science* 49(4) 817–829.
- Federgruen, Awi, Paul Zipkin. 1984. A combined vehicle routing and inventory allocation problem. *Operations Research* 32(5) 1019–1037. Gallego, Guillermo, David Simchi-Levi. 1990. On the effectiveness of direct shipping strategy for the one-warehouse multi-retailer r-systems. *Management Science* 36(2) 240–243.
- Golden, C., A. Assad, R. Dahl. 1984. Analysis of a large scale vehicle routing problem with an inventory component. *Large Scale Systems in Information and Decision Technologies* 7(2-3) 181–190.
- Iassinovskaia, Galina, Sabine Limbourg, Fouad Riane. 2017. The inventory-routing problem of returnable transport items with time windows and simultaneous pickup and delivery in closed-loop supply chains. *International Journal of Production Economics* 183(Part B) 570 – 582. doi:https://doi.org/10.1016/j.ijpe.2016.06.024.
- Li, Kunpeng, Bin Chen, Appa Iyer Sivakumar, Yong Wu. 2014. An inventory–routing problem with the objective of travel time minimization. *European Journal of Operational Research* 236(3) 936 – 945. doi:https://doi.org/10.1016/j.ejor.2013.07.034. *Vehicle Routing and Distribution Logistics*.
- Li, Yanhui, Hao Guo, Lin Wang, Jing Fu. 2013. A hybrid genetic-simulated annealing algorithm for the location-inventory-routing problem considering returns under e-supply chain environment. *The Scientific World Journal* 2013.
- Liu, Bailing, Hui Chen, Yanhui Li, Xiang Liu. 2015. A pseudo-parallel genetic algorithm integrating simulated annealing for stochastic location-inventory-routing problem with consideration of returns in e-commerce. *Discrete Dynamics in Nature and Society* 2015.
- Liu, Shu-Chu, Chich-Hung Chung. 2009. A heuristic method for the vehicle routing problem with backhauls and inventory. *Journal of Intelligent Manufacturing* 20(1) 29–42.
- Mes, Rivera, Schutten. 2014. Inventory routing for dynamic waste collection. *Waste Management* 34(9) 1564 – 1576. Persson, Jan A., Maud G“othe-Lundgren. 2005. Shipment planning at oil refineries using column generation and valid inequalities. *European Journal of Operational Research* 163(3) 631 – 652.

- Raa, Birger, El-Houssaine Aghezzaf. 2008. Designing distribution patterns for long-term inventory routing with constant demand rates. *International Journal of Production Economics* 112(1) 255–263.
- Savelsbergh, Martin, Jin-Hwa Song. 2008. An optimization algorithm for the inventory routing problem with continuous moves. *Computers & operations research* 35(7) 2266– 2282.
- Sindhuchao, Sombat, H Edwin Romeijn, Elif Akçali, Rein Boondiskulchok. 2005. An integrated inventory-routing system for multi-item joint replenishment with limited vehicle capacity. *Journal of Global Optimization* 32(1) 93–118.
- Solyalı, Oğuz, Haldun Sural. 2008. A single supplier–single retailer system with an order-up-to level inventory policy. *Operations Research Letters* 36(5) 543 – 546. doi:<https://doi.org/10.1016/j.orl.2008.05.005>. URL <http://www.sciencedirect.com/science/article/pii/S0167637708000564>.
- Solyalı, Oğuz, Haldun Sural. 2011. A branch-and-cut algorithm using a strong formulation and an a priori tour-based heuristic for an inventory-routing problem. *Transportation Science* 45(3) 335–345.
- Soysal, Mehmet. 2016. Closed-loop inventory routing problem for returnable transport items. *Transportation Research Part D: Transport and Environment* 48(Supplement C) 31 – 45. doi:<https://doi.org/10.1016/j.trd.2016.07.001>.
- Speranza, Maria Grazia, Walter Ukovich. 1994. Minimizing transportation and inventory costs for several products on a single link. *Operations Research* 42(5) 879–894.
- Srivastava, Samir K. 2008. Network design for reverse logistics. *Omega* 36(4) 535 – 548. doi:<https://doi.org/10.1016/j.omega.2006.11.012>. Special Issue on Logistics: New Perspectives and Challenges.
- Vansteenwegen, Pieter, Manuel Mateo. 2014. An iterated local search algorithm for the single-vehicle cyclic inventory routing problem. *European Journal of Operational Research* 237(3) 802 – 813. doi:<https://doi.org/10.1016/j.ejor.2014.02.020>.
- Vidović, Milorad, Dražen Popović, Branislava Ratković. 2014. Mixed integer and heuristics model for the inventory routing problem in fuel delivery. *International Journal of Production Economics* 147(Part C) 593 – 604. doi:<https://doi.org/10.1016/j.ijpe.2013.04.034>. *Interdisciplinary Research in Operations Management*.
- Viswanathan, S., Kamlesh Mathur. 1997. Integrating routing and inventory decisions in one-warehouse multiretailer multiproduct distribution systems. *Management Science* 43(3) 294–312.
- Zhao, Qiu-Hong, Shuang Chen, Cun-Xun Zang. 2008. Model and algorithm for inventory/routing decision in a three-echelon logistics system. *European Journal of Operational Research* 191(3) 623–635.