Mechanical & Industrial Engineering
UNIVERSITY OF TORONTO

Factors Impacting the Ordering Decisions for Red Blood Cells (RBCs) in a Hospital Blood Bank

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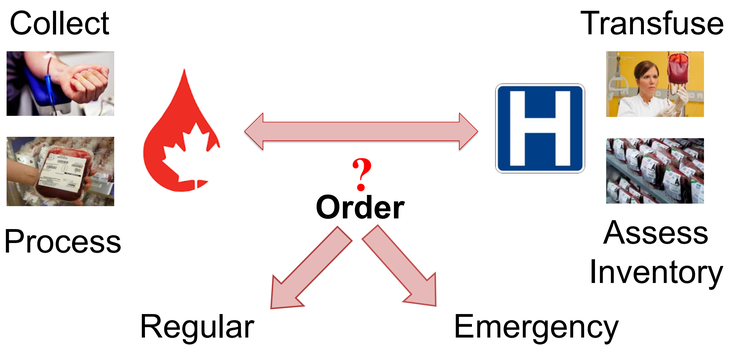
Background



- Canadian Blood Services (CBS) operates Canada's blood supply (except for Quebec).
- Hospitals routinely order the required RBC units from CBS's distribution centres.
- RBC units are perishable (shelf-life = 42 days).
- Current guidelines for ordering RBCs (consistent with the literature) are based on available inventory levels.

What factors affect the order quantities in practice?

Data Description

Transaction level data for RBC inventory received by a large academic hospital in Ontario.

Data for 2016 and 2017 was analyzed.

Emergency Order

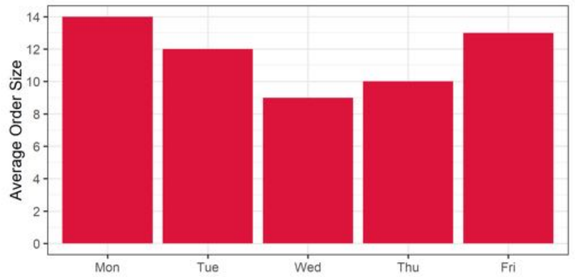
- Outside of the ROW*: %4.3
- Weekend: %4.1

Trace-driven Simulation

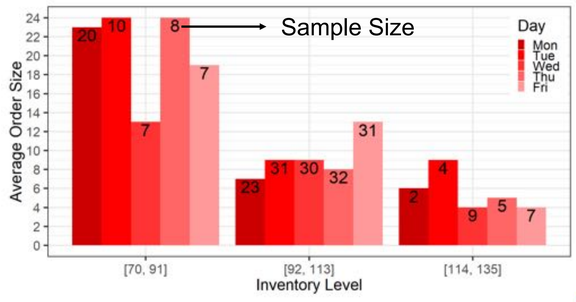
Used to compute order sizes and other relevant quantities (e.g., Inventory level) from the available data.

*Routine Ordering Window 8 AM – 2 PM

Potential Factors



Order size is different on each *day of the week*. It's relatively higher on Monday and Friday.



There is significant variation in order size on each day of the week even after controlling for inventory level.

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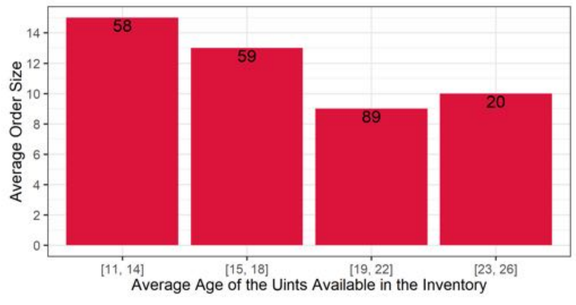
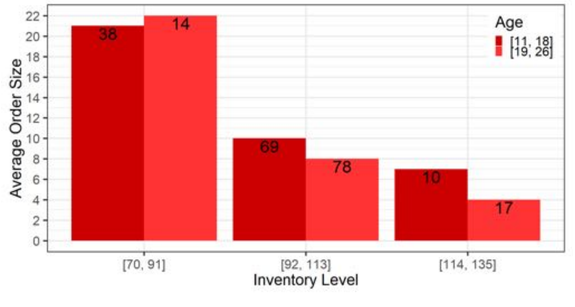


As the *average age* increases the order size first decreases and then increases.



The effect of age on order size still exists even after controlling for inventory level.

Hypotheses

Factor	Conjecture
Day of the week	More orders on Monday and Friday to avoid low inventory levels during the weekend.
Age of the units in the inventory	Order less to reduce the chance of expiry, and more to avoid low inventory level due to expiration or faster use of products available in the inventory.
Past Demand	High demand episodes lead to larger orders regardless of inventory levels.
Future Demand	Some orders are made based on future info. (e.g., demand for scheduled surgeries)

Linear Regression - Monday**

$$Order = 43.87 - 0.43(Inv_{lag_1}) + 0.87(Dem_{lag_2}) + 0.47(Dem_{lag_3})$$

LR - Wednesday**

$$Order = 42.6 - 0.24(Inv_{lag_1}) - 0.73(Age_{lag_1}) + 0.53(Dem_{lead_3})$$

**All covariates are statistically significant.

Ongoing Work

- Confirming the hypotheses using econometric analysis.
- Investigating their implications on optimal inventory control of RBCs.
- Examples: Considering variability in the age of new orders, Incorporating future information (e.g., demand for scheduled surgeries) and deviations from regular demand in optimizing ordering decisions.