Markdown optimization for fresh categories

For a retailer, ordering the right quantity of products is a crucial task on a daily level – too much quantity leads to food waste whereas too little leads to out-of-stock situations, lost sales, and dissatisfied customers. Excess stocks are particularly critical in fresh categories since the items must be sold off within a very short time due to their short best-before date. There are major differences between the individual fresh categories which need to be considered: while fresh baked goods need to be sold off completely on the same day, dairy products still have several days left.

In order to sell the items before they perish (e.g., before reaching the best before date), targeted discounts are given by the employees in the stores. If a price discount is too high, the remaining stock may be salvaged quickly, and the margin losses may be too high. On the other side, if the price discounts are too low, the risk of food waste increases. When determining the optimal discount, a retailer needs to define the number of discount phases (i.e., how often to reduce prices), the timing of discounts (i.e., when to start with discounting) and the depth of the discount (i.e., how much to reduce the prices). Various parameters influence these decisions like customer reactions in terms of price-elastic and freshness-dependent demand, long-term impact on customer base with different discounting policies, general and legal guidelines such as minimum and maximum reductions, special placement in sales corners etc.

The aim of this master's thesis is to develop an approach for profit-optimized markdown pricing in fresh categories (bakery, dairy and/ or counter) on a market-specific and item-specific level, with the goal to minimize the total write-offs and waste (losses from price reduction and remaining stock).

The tasks include:

- Complete a structured literature review about markdown policies for overstocks
- Structurally derive decision problem and formalize it as a stochastic-dynamic optimization model
- Implement the decision problem as a simulation model (e.g., in Python or AnyLogic)
- Collect data from Kaufland and prepare it for the application
- Complete numerical studies to generate some managerial insights
- Develop plan for potential implementation of the tool at Kaufland

A real-world dataset will be provided