# RFID in the Wild

## Analyzing Stocktake Data to Determine Detection Probabilities of Products

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# Motivation

## Traditional Stock-keeping Methods

- stock accuracy as low as 50%
- prevents adoption of state-of-the-art retail technologies

## RFID-based Stocktakes

- items are uniquely identifiable
- read without direct line-of-sight
- stock accuracy well above 90%

# Motivation

Readability of Products can be Influenced by Various Factors

- material composition
- product placement
- RFID tag placements
- ...

→ identifying products with such unfavorable characteristics is the key to further improve stock accuracy close to 100%

# Approach

## Stocktake Data

- recorded items in a store (read events)
- each item is associated with a unique product
- items are usually observed over multiple stocktakes
- sequence of *hits* and *misses* for each item

# Approach

## Item Detection Probabilities

- valuable but only limited information
  (broken RFID tags, unintentional shielding,...)

## Product Detection Probabilities

- aggregation (i.e., mean) of item detection probabilities belonging to the same product
  - across all stores (global)
  - for individual stores (local)

# Data Set

## Data Set Characteristics

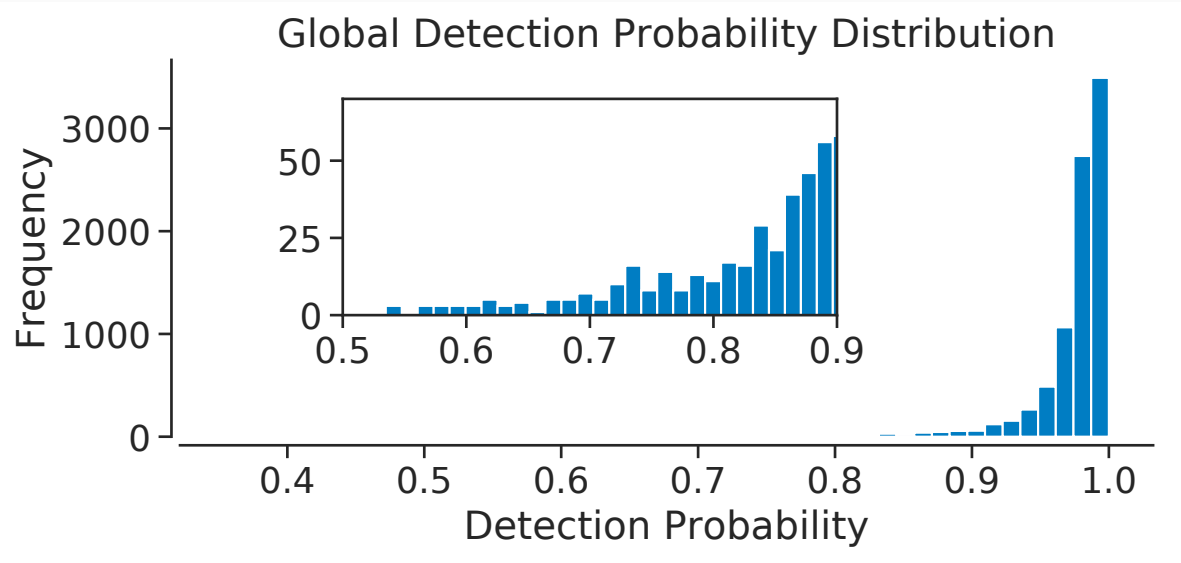
- stocktake data of 407 stores
- stores located in different regions (USA, Europe, and Asia)
- 32,256 completed stocktakes
- 564,022,373 read events of 8,728 distinct products

| | # stores | # stocktakes | stock accuracy | stock size |
|---|---|---|---|---|
| USA | 196 (48.16%) | 19,541 (6.4) | 92.45% | 22,808 |
| Europe | 199 (48.89%) | 11,465 (5.2) | 92.30% | 8,492 |
| Asia | 12 (2.950%) | 1,250 (7.3) | 94.44% | 4,340 |
| Overall | 407 (100.0%) | 32,256 | 92.47% | 17,004 |

# Analyzing Frequently Missed Products

## Global Product Detection Probability

- detectability already high: 0.971 (0.048)
- frequently missed products can be identified




- tops are in general more problematic

# Analyzing Frequently Missed Products

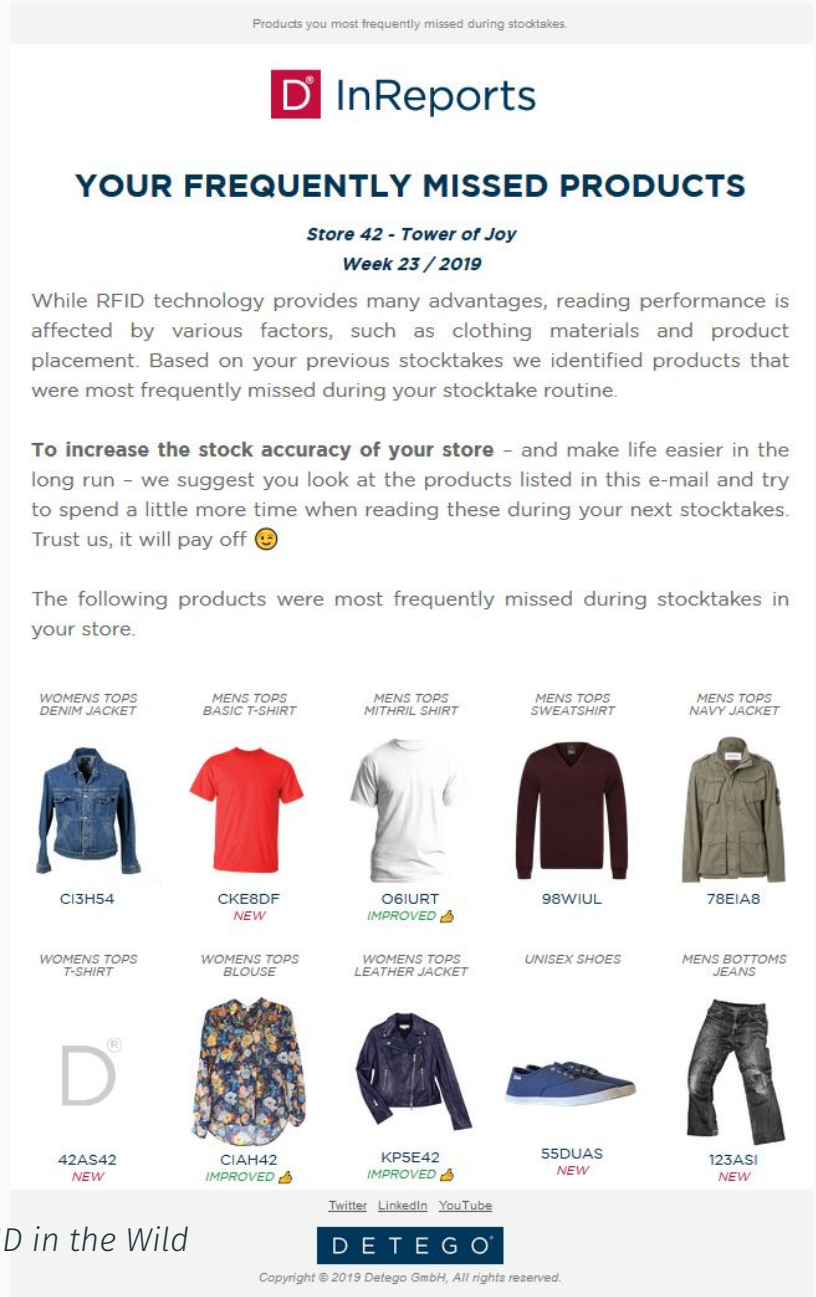
## Difference between Global and Local Detection Probabilities

- reading performance is rather homogeneous
- average difference: 0.0041 (0.036)

## Similarities within Regions

- top 20 most often missed products per store
- 18 (23) products in at least 10% of US (EU) stores
- some products in more than 80% of stores
- core-groups of frequently missed products exist

# Reporting Frequently Missed Products



Products you most frequently missed during stocktakes.

InReports

**YOUR FREQUENTLY MISSED PRODUCTS**

***Store 42 - Tower of Joy***
***Week 23 / 2019***

While RFID technology provides many advantages, reading performance is affected by various factors, such as clothing materials and product placement. Based on your previous stocktakes we identified products that were most frequently missed during your stocktake routine.

**To increase the stock accuracy of your store** – and make life easier in the long run – we suggest you look at the products listed in this e-mail and try to spend a little more time when reading these during your next stocktakes. Trust us, it will pay off 😉

The following products were most frequently missed during stocktakes in your store.

| WOMENS TOPS DENIM JACKET | MENS TOPS BASIC T-SHIRT | MENS TOPS MITHRIL SHIRT | MENS TOPS SWEATSHIRT | MENS TOPS NAVY JACKET |
|---|---|---|---|---|
| CI3H54 | CKE8DF NEW | O6IURT IMPROVED | 98WIUL | 78EIA8 |

| WOMENS TOPS T-SHIRT | WOMENS TOPS BLOUSE | WOMENS TOPS LEATHER JACKET | UNISEX SHOES | MENS BOTTOMS JEANS |
|---|---|---|---|---|
| 42AS42 NEW | CIAH42 IMPROVED | KP5E42 IMPROVED | 55DUAS NEW | 123ASI NEW |

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## Controlled User Study

- 16 European stores
- 15 weekly e-mail reports
- 630 products reported
- 51% products did improve (change in trend)

# Conclusion

## Contributions

- methodology to identify frequently missed products
- we find core-groups within regions and stores
- insights from real-world implementation (user study)
- extensive real-world dataset[1]

## Future Work

- real-time feedback on RFID handheld device
- experiment with different detectability measures

[1] `https://github.com/detegoDS/stocktake_reads_dataset`