OPTIMIZING THE COMMODITY FLOW SURVEY, v2

Economic Reimbursables Division / Commodity Flow Branch
James Hinckley — Branch Chief
OVERVIEW

- Commodity Flow Survey
- Commissioned by BTS
- Conducted every 5 years (2017, 2022)
- Respondents provide sampling of shipments from each quarter
OVERVIEW

- Commodity Flow Survey
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<table>
<thead>
<tr>
<th>Line No.</th>
<th>Your Shipment ID Number</th>
<th>Shipment Date</th>
<th>Shipment Value (excluding freight charges and excise taxes) in whole dollars, Estimates acceptable.</th>
<th>Net Shipment Weight in pounds, Estimates acceptable.</th>
<th>SCTG commodity code from accompanying booklet</th>
<th>Commodity Description</th>
<th>Is item in column (G) a hazardous material? Enter &quot;Y&quot;, &quot;N&quot;, or &quot;NA&quot;, number</th>
<th>Is item in column (G) a controlled commodity (Y/N)?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex.1</td>
<td>123-5</td>
<td>4 26</td>
<td>224,235</td>
<td>4,840</td>
<td></td>
<td>34520</td>
<td>Mechanical machinery</td>
<td>Y</td>
</tr>
<tr>
<td>Ex.2</td>
<td>402H</td>
<td>4 26</td>
<td>1,375</td>
<td>50,125</td>
<td></td>
<td>20222</td>
<td>Sulfuric acid</td>
<td>N</td>
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<tr>
<td>1</td>
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</tbody>
</table>
For shipments consisting of more than one commodity, report the code and description of the commodity that contributed the greatest weight of the shipment in columns (F) through (I).

<table>
<thead>
<tr>
<th>SCTG commodity code from accompanying booklet</th>
<th>Commodity Description</th>
<th>Is item in col (G) a hazardous material? Enter &quot;UN&quot; or &quot;NA&quot; number</th>
</tr>
</thead>
<tbody>
<tr>
<td>(F)</td>
<td>(G)</td>
<td>(H)</td>
</tr>
<tr>
<td>34520</td>
<td>Mechanical machinery</td>
<td>Y</td>
</tr>
<tr>
<td>20222</td>
<td>Sulfuric acid</td>
<td>N 1830</td>
</tr>
</tbody>
</table>
ITEM G - Other Clarifying Information

"Pulling this information was a huge spend of time and resources."

"Just glad this is over!!"
OBJECTIVE

Using Machine Learning, can we automate the assignment of SCTG codes to shipments?
OBJECTIVE

(spoiler alert)
OBJECTIVE

(spoiler alert)

YES!
METHOD

- Training Data: **6.4 million** labelled shipment records from 2017 CFS
- Bag-of-Words, Logistic Regression (logit) model
- Use shipment description and NAICS Code
  - "fasteners"
- Clean records, de-duplicate, disambiguate: ~**400,000 unique training records**
- Initial results: **50% accuracy** (on 40,000 unseen test set records)
METHOD

- Investigate poorly performing codes

- **40994**: Sewing and knitting needles (includes for machines) crochet hooks, hook and eye fasteners, safety pins, straight pins, buttons, buckles and clasps, tubular and bifurcated rivets, snap-fasteners, zippers, and similar notions.
- **33310**: Nails, screws, bolts, nuts, washers, staples except in strips, and similar *fastening* articles
MANUAL VALIDATION

- Manually validating, about 50% of items labelled 40994 by respondents were miscoded.

- However, the model was getting it right!
**RESULTS**

- **Proof-of-concept**: ran model on 170,000 unlabelled records
- 70,000 with confidence score above predefined threshold
- Manually validate a sample of 350 unique records
- **89% accurate!**
- Batch-edits have saved ~**500 hours** of manual editing time, $35,000
RESULTS

- 2022 CFS: save respondents **50,000+ hours, $2.1 million** in respondent lookup costs

- This **does not include** Census' editing costs, cleaning up invalid / messy data

- And, we get more, more accurate, and **real-time** shipment data!

- Cleaner data (via **Amazon's Mechanical Turk**) will improve these savings
  - **Better model == more savings**
ACKNOWLEDGMENTS

- James Hinckley, CFS Branch Chief
- Jessica Young/Berin Linfors, CFS Section Chiefs
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THANK YOU!

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