

Using Artificial Intelligence and Industry and Occupation Narratives to Identify Alternative Work Arrangements

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This project evaluated different AI automation approaches to use narratives obtained to assign standardized industry and occupation codes for a different purpose: to classify heterogeneity in self-employment in the 1997-2019 waves of the Panel Study of Income Dynamics (PSID)

We classified reports into five work arrangements

Work Arrangement	Job Characteristics
Platform gig work	Identifies platform name (including platforms identified by Harris and Krueger (2015) or on Wikipedia at the time of the classification) or gives other indication of working on a platform
Business owner or president, or owner of family farm	Says they own or run a business OR mentions business assets AND lists business name
Self-employed, informal (non-contract) basis	Working in roles such as a babysitter, caregiver, cleaner, handyman, doing odd/spare jobs, day laborer, maker, performer, seasonal work, multi-level marketing, sales, freelancer
Self-employed, formal (independent contractor) basis	Working in roles such as an independent contractor, subcontractor, consultant, working for an “umbrella” company (e.g., real estate agent at real estate company, financial planner at advisor company)
Employee	Does not report any of the above roles and reports working for someone else for pay

We evaluated the use of seven models:

- Traditional machine learning models
 - Decision Trees
 - Support Vector Machines
 - k-Nearest Neighbors
 - Naïve Bayes
 - Random Forests
 - Gradient Boosted Trees (GB)
- Transformer-based model: Bidirectional Encoder Representations from Transformers (BERT)

Among the traditional machine learning models evaluated, GB achieved the strongest performance and was therefore used as a representative baseline to compare with BERT

We find that BERT achieves a higher F-1 Score and overall accuracy than the GB model

	GB	BERT
Weighted F1-Score	0.74	0.87
Overall Accuracy	0.78	0.87

Using modern AI automation techniques enables production of new variables of interest from existing open-ended text data

BERT generally outperforms the GB model for each work arrangement category

	GB		BERT		Wtd. Share
	Precision	Recall	Precision	Recall	
Platform Gig Work	0.55	0.37	0	0	0.5%
Informal SE	0.73	0.35	0.75	0.81	13.9%
Formal SE	0.71	0.27	0.54	0.59	9.1%
Bus. Owner.	0.73	0.36	0.68	0.51	7.0%
WS Emp.	0.79	0.98	0.96	0.97	69.5%

The BERT model confusion matrix reports patterns in incorrect predictions

		Predicted				
		Platform Gig Work	Informal SE	Formal SE	Bus. Owner.	WS Emp.
Actual	Platform Gig Work	0	14	2	1	8
	Informal SE	0	544	72	17	40
	Formal SE	0	82	260	53	48
	Bus. Owner.	0	45	94	176	27
	WS Emp.	0	36	57	13	3275

Predicted categories show distinct characteristics

	Informal SE	Formal SE	Bus. Own.	WS Emp.
% Own a Bus. - PY	34.5 (1.86)	54.9 (2.13)	83.9 (1.71)	9.1 (0.48)
% with Pos. Bus. Assets	21.8 (1.37)	39.9 (2.11)	72.4 (2.20)	6.3 (0.42)
Z-Score Abstract Skill	-0.31 (0.04)	0.25 (0.05)	0.78 (0.05)	0.14 (0.02)
Z-Score Routine Skill	-0.17 (0.03)	-0.07 (0.04)	-0.25 (0.04)	0.04 (0.01)
Z-Score Manual Skill	0.24 (0.04)	0.02 (0.05)	-0.08 (0.04)	-0.04 (0.01)
Observations	3,177	2,097	2,329	60,105
Weighted Share	4.7%	3.1%	3.4%	88.8%

Take-aways

- The BERT-based model outperformed the best-performing traditional machine learning model, Gradient Boosted Trees (GB), particularly in its handling of class imbalance
- Our work arrangement categories reflect substantially different work characteristics that are masked in other data sources
- These findings support using modern AI automation techniques to reduce the burden of classifying open-ended questions and to identify new variables in existing data
- This work highlights the potential for adding open-ended questions to surveys