# Predicting the Award Price of First Price Sealed Bid Procurement Auctions

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# Motivation: The Importance of Public Auctions

Auctions are a vital tool for governments to procure contracts. For construction contracts, first price sealed bid auctions are of particlar importance.

- The authorities of the European Union for example spent around 14% of their GDP on public procurement in 2017 (Rodríguez et al. 2020).
- ➤ Similar observatios can be made for the U.S. economy, one state of particulat importance for this thesis is Colorado.
- In 2021 the Budget for Transportation in Colorado amounted to roughly \$2 billion. Out of this Budget the CDOT awarded \$790 millions worth of contracts to construct design and repair bridges and highways. All of those contracts were procured via first price sealed bid auctions.

#### Thesis Overview

- Provide an award price prediction model for the Colorado Department of Transportation.
  - This model would enable the auctioning entity to plan their budget more accurately.
- Unsupervised Collusion Detection
  - Examine whether the interaction of certain bidders has an effect on award prices. A significant interaction effect could allude to bid rigging schemes.

## Data: Source

# An example of a bid tab, as published on the website of the CDOT.

			rtment Of Transportation	Р	rinted On:	11/17/2015
		Ve	ndor Ranking			Page 1 of 1
Letting No:	20151112	Contract ID:	C19868	Project(s):	STU1211-0	084
Letting Date:	November 12, 2015	Region:	1			
Letting Time:	10:00 AM	Contract Time:	260 WORKING DAYS	Counties:	JEFFERSO REGION 1	ON,
Contract Desc SH121(WADS	ription: WORTH)-HIGHLAND DR-10	TH AVE-JEFFERSON	со			
THIS PROJEC	CT IS LOCATED ON WADSV	VORTH BETWEEN HIG	GHLAND AND 10TH.			
LANE IN BOTI MAINLINE PA	ION WILL INCLUDE A FULL H DIRECTIONS, AND A MUI VING WILL BE CONCRETE.	TI MODAL TRAIL ON THE WORK ALSO IN	BOTH SIDES. THE			

Rank	Vendor ID	Vendor Name	Total Bid	Percent Of Low Bid	Percent Of Estimate
0	-EST-	Engineer's Estimate	\$9,821,027.20	91.58%	100.00%
1	870A	SEMA CONSTRUCTION, INC.	\$10,723,550.00	100.00%	109.19%
2	884A	HAMON INFRASTRUCTURE, INC.	\$10,817,000.00	100.87%	110.14%
3	1275A	CASTLE ROCK CONSTRUCTION COMPANY OF COLORADO, LLC	\$10,817,845.03	100.88%	110.15%
4	065A	CONCRETE WORKS OF COLORADO INCORPORATED	\$11,614,565.78	108.31%	118.26%
5	232A	AMERICAN CIVIL CONSTRUCTORS, INC. dba ACC Mountain West	\$12,338,888.00	115.06%	125.64%

CONTACT BID EXPRESS CUSTOMER SERVICE AT 1-888-352-2439 TO OBTAIN AN

ACCOUNT IF NECESSARY.

Figure 1: Bid Tab Example

# Data: Extraction

- ▶ The following text based data was extracted utilizing the package *pdftools* and regular expressions (Ooms 2022):
  - ► Contract ID
  - County
  - Contract Time
  - Contract Description
- ➤ The table containing the bids, the unique bidder intentifiers and the engineer's estimate was extracted utilizing the R package tabulizer (Leeper 2018).

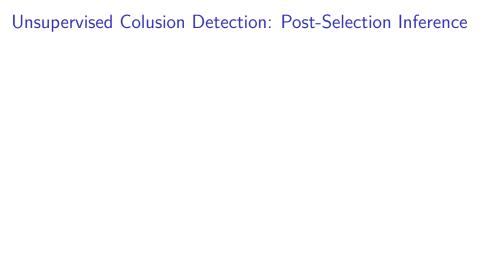
#### Data: Final Dataset

The final dataset features 430 observations and 1087 variables.

- County
- Letting month
- Letting year
- Contract time
- Number of bidders
- ► Engineer's estimate
- Award price
- ▶ 169 binary variables, representing the bidder identities
- ▶ 652 binary variables, representing pair-wise bidder interaction terms
- ▶ 258 binary variables, representing the contract description hit words

# Methods: Elastic Net

Results: Best Prediction Model



### References

- Leeper, Thomas J. 2018. *Tabulizer: Bindings for Tabula PDF Table Extractor Library.*
- Ooms, Jeroen. 2022. Pdftools: Text Extraction, Rendering and Converting of PDF Documents.
  - https://CRAN.R-project.org/package = pdftools.
- Rodríguez, Manuel J. García, Vicente Rodríguez Montequín, Francisco Ortega Fernández, and Joaquín M. Villanueva Balsera. 2020. "Bidders Recommender for Public Procurement Auctions Using Machine Learning: Data Analysis, Algorithm, and Case Study with Tenders from Spain." *Complexity* 2020: 1–20. https://doi.org/10.1155/2020/8858258.