
CO MONITORS IN U.S. HOMES

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CO POISONING IS DANGEROUS



- Carbon Monoxide (CO) poisoning is a condition that can cause serious damage or death
 - CO is formed by the incomplete combustion of fuel found in many U.S. homes.
 - Proper safety procedures can limit the harm from CO poisoning
 - The Consumer Product Safety Commission (CPSC) establishes many programs to limit CO poisoning.



CO MONITORS MITIGATE POISONING RISK

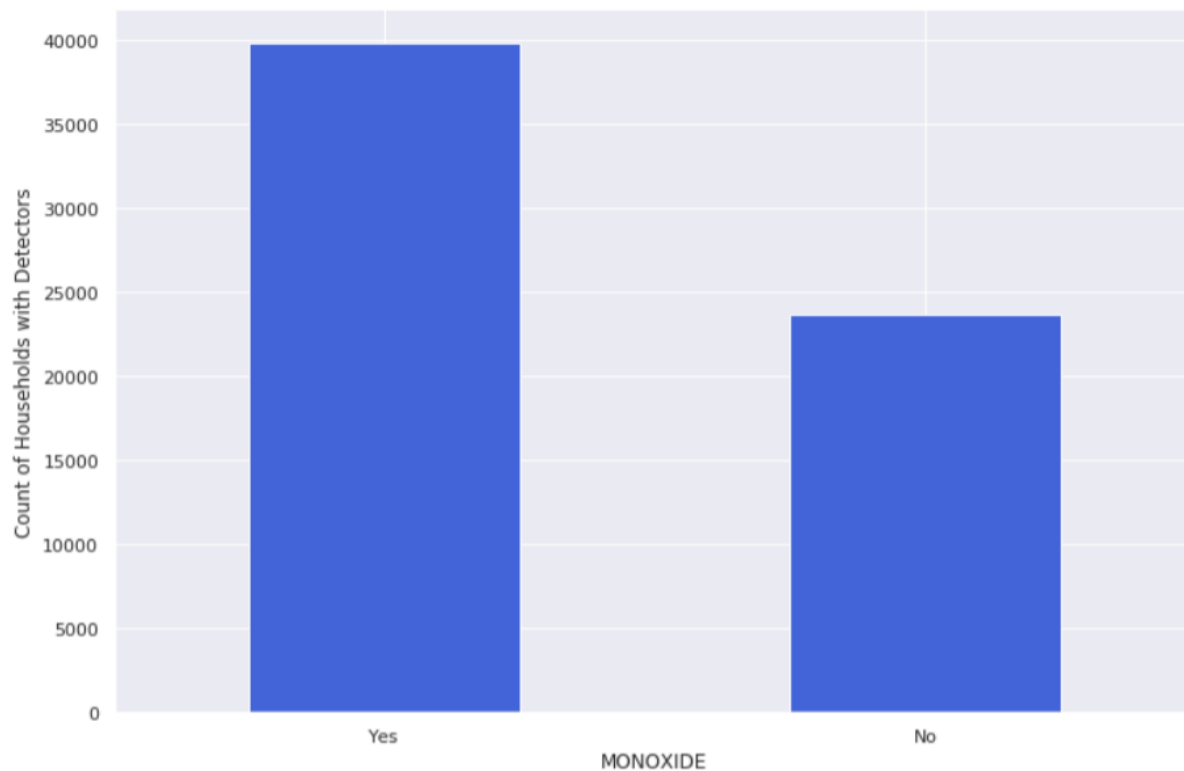
- In a CPSC document, CO monitors were found to significantly reduce the risk of death in a CO poisoning incident
- The U.S. Census Bureau collects household information in its Annual Housing Survey (AHS), including CO monitor status
 - The 2017 AHS contains over 66,000 household responses on over 3000 topics
 - AHS data can be used to predict the households most at risk of not owning a CO monitor

OUR ANALYSIS

- We analyzed 18 response variables from the 2017 AHS to see what factors link to CO monitor status, including 14 predictors:
 - Primary air conditioning system
 - Secondary air conditioning system
 - Type of heating equipment
 - Fuel of heating equipment
 - Hot water system
 - Household income
 - Homeowners association status (HOA)
 - Year the household was built
 - Rent Payment
 - Rent control status
 - Marital status
 - Educational attainment
 - Race
 - Household language

EXPLORATORY DATA ANALYSIS

A significant number of households do not have CO monitors

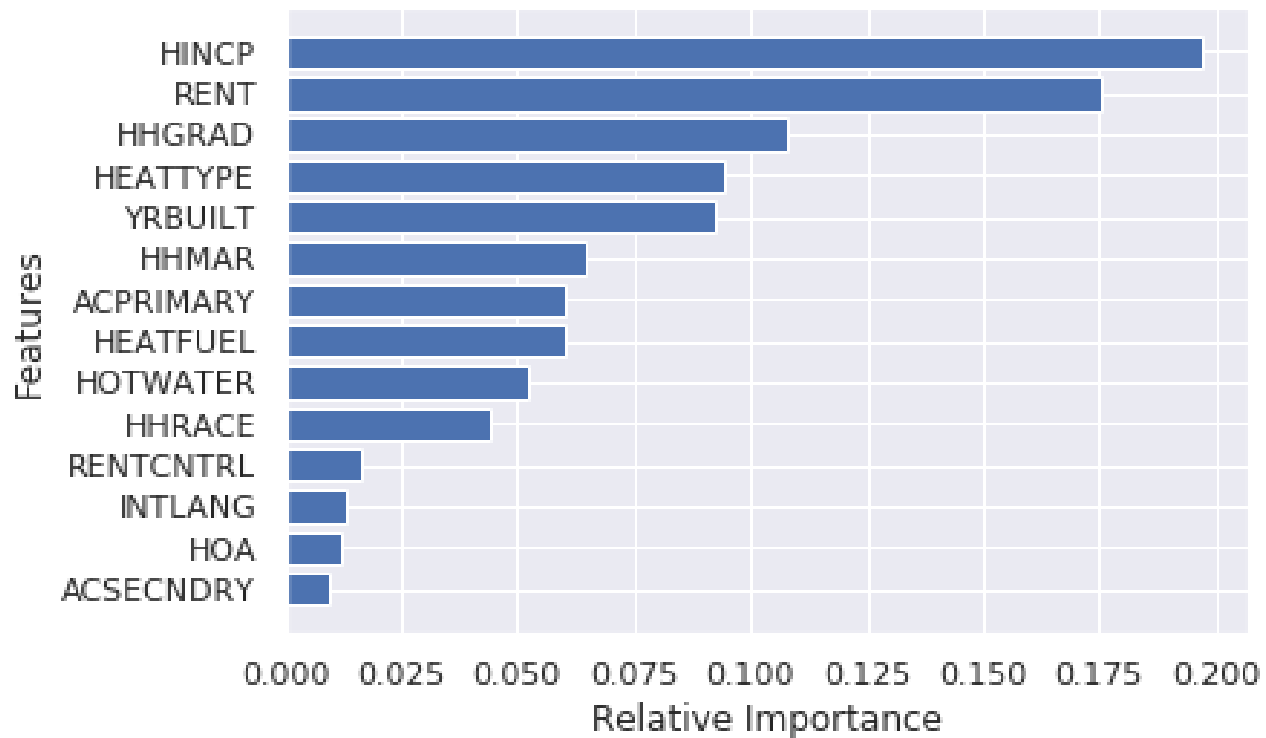


We also found other interesting aspects of the dataset:

- Income varied between \$0 and over \$5M annually
- Most homes use a furnace for heat
- Appliance fuel types vary, but electricity and gas are common

MODELING CO MONITOR STATUS

The most important features are income, rent status, education level, heat type, and year built



Feature	Relationship to CO Monitor Presence
Higher income	Increased likelihood
Higher rent	Decreased likelihood
Higher education level	Decreased likelihood
Fuel-burning heat	Increased likelihood
Newer homes	Increased likelihood



MODELING CO MONITOR STATUS

- The models we ran obtained moderate accuracy and had moderate misclassification rates after analyzing the most important features.
- Random forest obtained an accuracy of approximately 62%
- Household income alone predicts CO monitor status with approximately 58% accuracy under logistic regression
- Ensembling the models did not increase model performance

CONCLUSIONS

- Household income, rent status, education level, heat type, and year built are key predictors of CO monitor presence
- Households with low income, higher rent, higher education, older homes, and electric appliances are all less likely to have a CO monitor
- Some counterintuitive relationships exist between predictors and CO monitor status
- Government agencies like CPSC could use this modeling information to help marshal resources to target homes most at risk of CO poisoning