

ROOT Insurance Challenge

An Executive Summary of Two Modeling Approaches

The Problem: Acme Insurance would like to optimize their ad spending on a vertical search website. Customers provide some personal information, and companies then bid to show them their ads based on their information. Ad placement is determined by the insurer's bid, with higher bids being shown before lower bids, and companies only pay their bids if their ad is clicked on.

Available Data: Acme has been utilizing a flat \$10 bid strategy and has a set of 10,000 ad impressions that record the customer-provided information, what rank an ad was displayed at, whether it was clicked on, and whether it led to a policy sale. This strategy produced 783 policy sales with a cost per sale of \$23.98.

Specific Goal: Acme would like to find the most cost-effective strategy that will be expected to yield at least 400 policy sales for every 10,000 ads shown.

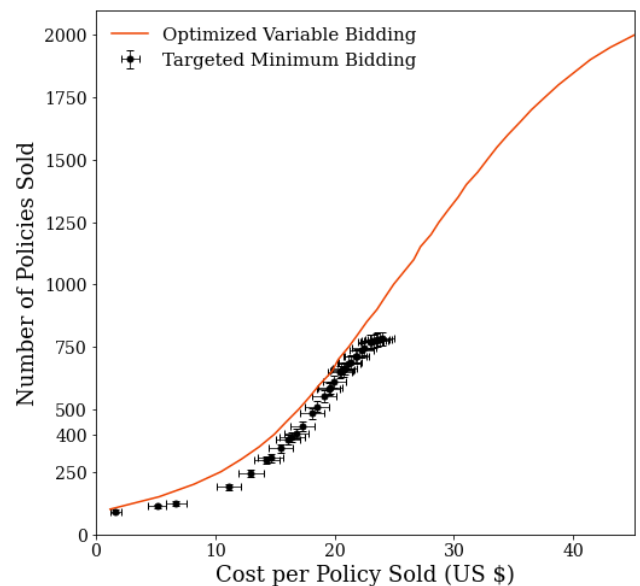
Exploratory Analysis Insights: I identified two notable aspects of the data which will underpin most of my subsequent modeling:

1. Ad rank placement drives clicks, not sales. Although ads displayed first are far more likely to be clicked on, there is no evidence that customers are any more likely to purchase a policy based on its display rank once they've actually clicked on it.
2. After clicking on an ad, different customer categories exhibit statistically significant variation in how likely they are to purchase a policy.

Targeted Minimum Bidding: The idea for this model is fairly straightforward – Bid \$10 for customers that are likely to purchase policies after clicking on an ad, but only \$0.01 for those who are not. This is a very safe model, relying only on the assumption that competitor bid strategies and customer demographics will not change significantly during the next ad campaign. For a strategy that is expected to sell just over 400 policies, this approach cuts the cost per policy sold to \$16.79, a 30% savings over flat \$10 bidding.

Optimized Variable Bidding: Since Acme previously utilized a flat bid strategy, we cannot directly estimate how changing bids will shift ad rank. We can, however, build a reasonable model around the assumption that increasing a bid by \$2.50 would shift the expected display ranks up one slot. If this assumption holds, we can obtain 400 policy sales at a cost per policy of just \$14.87, a 38% savings over flat \$10 bidding and an 11% savings over targeted minimum bidding. The extent to which the fundamental assumption of this model is valid is uncertain and cannot be directly measured here, so estimates from this model should be taken with a sizable grain of salt.

Broader Strategy Options: Acme's stated goal is to identify strategies that will efficiently achieve 400 policy sales. However, both of these models allow us to identify a much wider range of possible strategies, and both can achieve more sales if we allow for increased ad spending. The targeted minimum bid model is limited to sales goals of up to 783 policies and becomes markedly less efficient near this limit, since at the extreme end it reduces to flat \$10 bidding. Optimized variable bidding is much more versatile, capable of achieving sales goals of 2000 policies or more, although as described above the validity of the model itself is considerably more uncertain. Thus further analysis using data from future ad campaigns that utilize different bid strategies is likely to be worthwhile.



Root Insurance Challenge

Targeted Minimum Bid Strategy That Yields 400 Sales

The Set ID 10 bid strategy, printed below, is expected to yield 402.2 policy sales, at a cost per policy of \$16.79.

Insured: N	Vehicles: 3.0	Drivers: 1.0	Marital Status: M	Bid: \$10.00
Insured: N	Vehicles: 1.0	Drivers: 1.0	Marital Status: S	Bid: \$10.00
Insured: N	Vehicles: 1.0	Drivers: 1.0	Marital Status: M	Bid: \$10.00
Insured: U	Vehicles: 1.0	Drivers: 1.0	Marital Status: S	Bid: \$10.00
Insured: U	Vehicles: 1.0	Drivers: 2.0	Marital Status: M	Bid: \$10.00
Insured: U	Vehicles: 1.0	Drivers: 1.0	Marital Status: M	Bid: \$10.00
Insured: N	Vehicles: 3.0	Drivers: 2.0	Marital Status: M	Bid: \$10.00
Insured: U	Vehicles: 2.0	Drivers: 1.0	Marital Status: M	Bid: \$10.00
Insured: Y	Vehicles: 1.0	Drivers: 1.0	Marital Status: S	Bid: \$10.00
Insured: N	Vehicles: 2.0	Drivers: 2.0	Marital Status: S	Bid: \$10.00
Insured: N	Vehicles: 2.0	Drivers: 2.0	Marital Status: M	Bid: \$10.00
Insured: U	Vehicles: 3.0	Drivers: 2.0	Marital Status: M	Bid: \$00.01
Insured: U	Vehicles: 1.0	Drivers: 2.0	Marital Status: S	Bid: \$00.01
Insured: N	Vehicles: 1.0	Drivers: 2.0	Marital Status: M	Bid: \$00.01
Insured: U	Vehicles: 2.0	Drivers: 1.0	Marital Status: S	Bid: \$00.01
Insured: N	Vehicles: 1.0	Drivers: 2.0	Marital Status: S	Bid: \$00.01
Insured: N	Vehicles: 2.0	Drivers: 1.0	Marital Status: M	Bid: \$00.01
Insured: U	Vehicles: 3.0	Drivers: 1.0	Marital Status: S	Bid: \$00.01
Insured: U	Vehicles: 2.0	Drivers: 2.0	Marital Status: S	Bid: \$00.01
Insured: Y	Vehicles: 2.0	Drivers: 2.0	Marital Status: M	Bid: \$00.01
Insured: Y	Vehicles: 3.0	Drivers: 2.0	Marital Status: S	Bid: \$00.01
Insured: N	Vehicles: 3.0	Drivers: 1.0	Marital Status: S	Bid: \$00.01
Insured: U	Vehicles: 3.0	Drivers: 1.0	Marital Status: M	Bid: \$00.01
Insured: Y	Vehicles: 2.0	Drivers: 1.0	Marital Status: M	Bid: \$00.01
Insured: Y	Vehicles: 1.0	Drivers: 2.0	Marital Status: M	Bid: \$00.01
Insured: N	Vehicles: 2.0	Drivers: 1.0	Marital Status: S	Bid: \$00.01
Insured: Y	Vehicles: 1.0	Drivers: 2.0	Marital Status: S	Bid: \$00.01
Insured: Y	Vehicles: 1.0	Drivers: 1.0	Marital Status: M	Bid: \$00.01
Insured: U	Vehicles: 2.0	Drivers: 2.0	Marital Status: M	Bid: \$00.01
Insured: Y	Vehicles: 2.0	Drivers: 1.0	Marital Status: S	Bid: \$00.01
Insured: N	Vehicles: 3.0	Drivers: 2.0	Marital Status: S	Bid: \$00.01
Insured: Y	Vehicles: 3.0	Drivers: 1.0	Marital Status: S	Bid: \$00.01
Insured: Y	Vehicles: 3.0	Drivers: 1.0	Marital Status: M	Bid: \$00.01
Insured: Y	Vehicles: 2.0	Drivers: 2.0	Marital Status: S	Bid: \$00.01
Insured: Y	Vehicles: 3.0	Drivers: 2.0	Marital Status: M	Bid: \$00.01

Root Insurance Challenge

Optimized Variable Bid Strategy That Yields 400 Sales

The following bid strategy is expected to yield 400.1 policy sales, at a cost per policy of \$14.87.

Insured: N	Vehicles: 3.0	Drivers: 1.0	Marital Status: M	Bid: \$6.20
Insured: N	Vehicles: 1.0	Drivers: 1.0	Marital Status: S	Bid: \$9.12
Insured: N	Vehicles: 1.0	Drivers: 1.0	Marital Status: M	Bid: \$9.12
Insured: U	Vehicles: 1.0	Drivers: 1.0	Marital Status: S	Bid: \$9.12
Insured: U	Vehicles: 1.0	Drivers: 2.0	Marital Status: M	Bid: \$8.00
Insured: U	Vehicles: 1.0	Drivers: 1.0	Marital Status: M	Bid: \$9.12
Insured: N	Vehicles: 3.0	Drivers: 2.0	Marital Status: M	Bid: \$5.77
Insured: U	Vehicles: 2.0	Drivers: 1.0	Marital Status: M	Bid: \$6.20
Insured: Y	Vehicles: 1.0	Drivers: 1.0	Marital Status: S	Bid: \$6.45
Insured: N	Vehicles: 2.0	Drivers: 2.0	Marital Status: S	Bid: \$5.77
Insured: N	Vehicles: 2.0	Drivers: 2.0	Marital Status: M	Bid: \$5.77
Insured: U	Vehicles: 3.0	Drivers: 2.0	Marital Status: M	Bid: \$5.77
Insured: U	Vehicles: 1.0	Drivers: 2.0	Marital Status: S	Bid: \$8.00
Insured: N	Vehicles: 1.0	Drivers: 2.0	Marital Status: M	Bid: \$8.00
Insured: U	Vehicles: 2.0	Drivers: 1.0	Marital Status: S	Bid: \$6.20
Insured: N	Vehicles: 1.0	Drivers: 2.0	Marital Status: S	Bid: \$8.00
Insured: N	Vehicles: 2.0	Drivers: 1.0	Marital Status: M	Bid: \$6.20
Insured: U	Vehicles: 3.0	Drivers: 1.0	Marital Status: S	Bid: \$6.20
Insured: U	Vehicles: 2.0	Drivers: 2.0	Marital Status: S	Bid: \$5.77
Insured: Y	Vehicles: 2.0	Drivers: 2.0	Marital Status: M	Bid: \$0.01
Insured: Y	Vehicles: 3.0	Drivers: 2.0	Marital Status: S	Bid: \$0.01
Insured: N	Vehicles: 3.0	Drivers: 1.0	Marital Status: S	Bid: \$6.20
Insured: U	Vehicles: 3.0	Drivers: 1.0	Marital Status: M	Bid: \$6.20
Insured: Y	Vehicles: 2.0	Drivers: 1.0	Marital Status: M	Bid: \$0.01
Insured: Y	Vehicles: 1.0	Drivers: 2.0	Marital Status: M	Bid: \$3.76
Insured: N	Vehicles: 2.0	Drivers: 1.0	Marital Status: S	Bid: \$6.20
Insured: Y	Vehicles: 1.0	Drivers: 2.0	Marital Status: S	Bid: \$3.76
Insured: Y	Vehicles: 1.0	Drivers: 1.0	Marital Status: M	Bid: \$6.45
Insured: U	Vehicles: 2.0	Drivers: 2.0	Marital Status: M	Bid: \$5.77
Insured: Y	Vehicles: 2.0	Drivers: 1.0	Marital Status: S	Bid: \$0.01
Insured: N	Vehicles: 3.0	Drivers: 2.0	Marital Status: S	Bid: \$5.77
Insured: Y	Vehicles: 3.0	Drivers: 1.0	Marital Status: S	Bid: \$0.01
Insured: Y	Vehicles: 3.0	Drivers: 1.0	Marital Status: M	Bid: \$0.01
Insured: Y	Vehicles: 2.0	Drivers: 2.0	Marital Status: S	Bid: \$0.01
Insured: Y	Vehicles: 3.0	Drivers: 2.0	Marital Status: M	Bid: \$0.01