

Targeting with List Scoring at Orange Apron

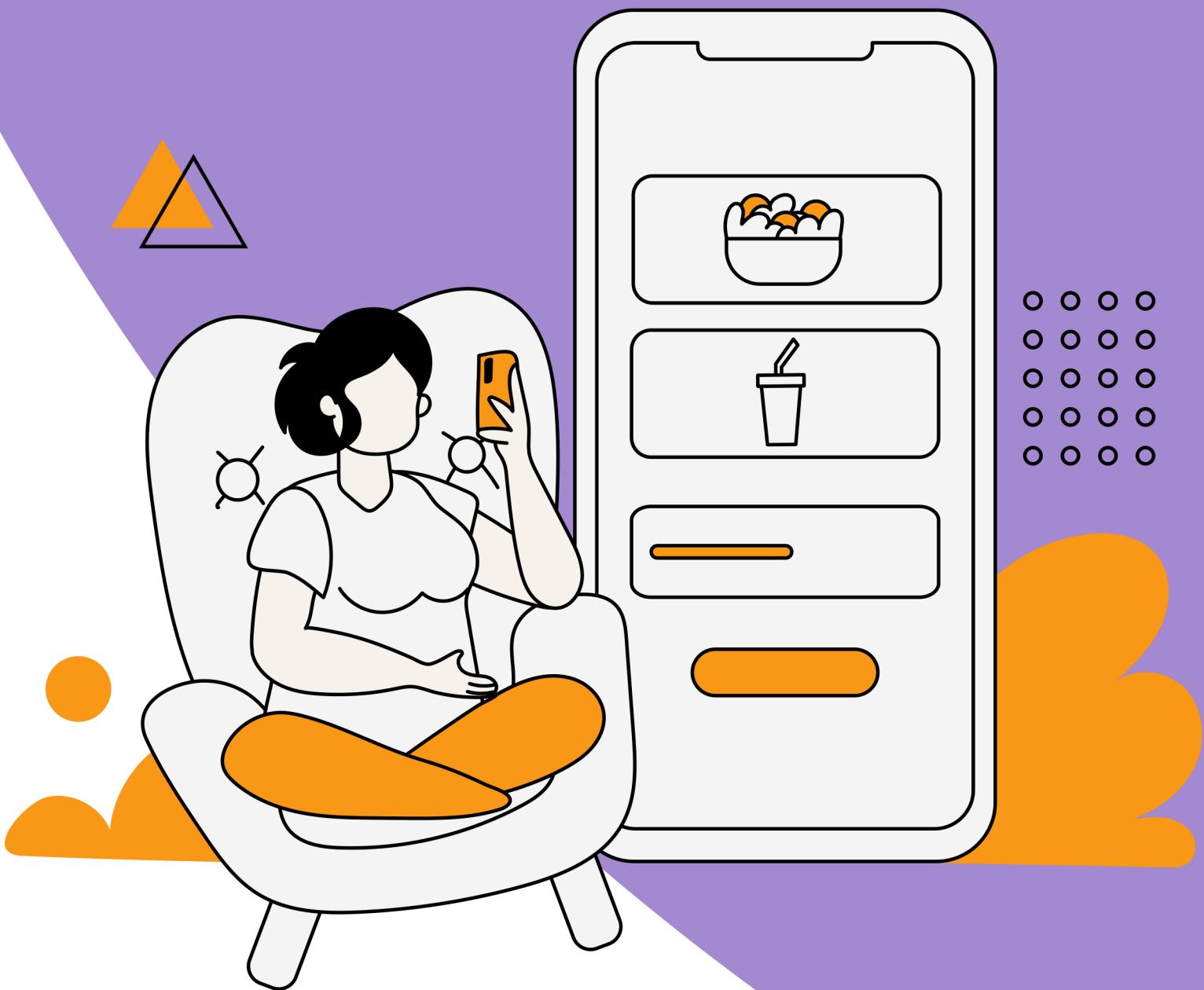
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Background-i

Orange Apron is a subscription-based meal delivery service that provides subscribers with three meal kits per week for 52 weeks of the year. Orange Apron is considering a **customer acquisition campaign** and plans to run a **field experiment** to determine appropriate target customers.

To implement the campaign, Orange Apron has **rented a list containing information on 500 households**. The list contains some information about the households captured in four variables. The first variable is a binary indicator of **whether children are present in the household** (1=yes, 0=no). The remaining variables are three **“hotline” buying indices**. Similar to a credit rating, these indices are variables computed by the list owner and represent different index variables that generally indicate positive or negative purchase interest (for different product categories, some indices are positively correlated with purchase interest while other indices are negatively correlated with purchase interest).



Background-ii

In consultation with the list owner, Orange Apron has selected three hotline indices, h1, h2, and h3. **Orange Apron's hypothesis is that h1 is positively correlated with interest in a meal delivery service while h2 and h3 are negatively correlated with interest in a meal delivery service. In addition, Orange Apron feels the presence of children in the household may increase interest in the service.**

Orange Apron has sent an invitation to all 500 names on the list to join the service. The invitation offer includes a deep discount on three weeks of service. We observe whether or not each of the 500 consumers accepted the invitation: **the value of y is 1 if the person joined the service and the value is 0 otherwise.** We use a random sample of 244 persons as the estimation sample, the second list of 256 is used to test list scoring and evaluate how successful the target selection was. The **244-person list** will henceforth be referred to as **the estimation list**, and the **256-person list** will be referred to as the **holdout list**.



estimation list

	children in					y
id	HH	hl1	hl2	hl3		
1	1	30	0	0		0
2	0	22	10	26		0
3	0	20	45	13		0
4	1	15	15	0		0
5	0	4	15	0		0
6	1	18	0	0		1
7	1	16	0	0		0
15	0	5	0	0		1
16	1	16	0	13		1
17	0	21	20	13		0
18	1	15	20	0		0
19	0	6	0	0		0
22	1	38	20	0		1
24	0	31	15	0		1
25	1	26	0	0		0
26	0	5	10	0		0
29	1	4	0	0		0
30	0	46	10	13		1
31	1	10	0	13		0
34	0	37	10	13		0
37	0	17	0	0		0
40	0	25	20	41		1
42	1	15	20	0		0

holdout list

	children in HH	hl1	hl2	hl3	y
id					
8	1	47	40	0	1
9	0	45	20	26	0
10	0	11	0	15	0
11	0	17	10	0	0
12	0	9	0	0	0
13	0	22	10	13	1
14	0	35	35	13	0
20	0	14	0	0	0
21	1	17	0	13	1
23	0	12	0	0	0
27	1	6	10	0	0
28	1	26	0	0	1
32	0	30	15	0	1
33	1	20	10	0	0
35	0	24	15	0	0
36	0	15	15	0	0
38	1	31	15	0	1
39	0	30	35	13	0
41	0	8	0	15	1
43	0	30	15	0	1
46	1	14	15	0	0
47	0	14	0	0	0
48	0	33	45	0	0
49	1	15	15	0	1
50	0	25	10	0	1



Y - the decision to join the club
X - available scoring variables
(children in HH and 3 hotline variables)
Model - Logistic Regression

Source	Value	Standard error	Wald Chi-Square	Pr > Chi ²	Wald Lower bound (95%)	Wald Upper bound (95%)	Odds ratio	Odds ratio Lower bound (95%)	Odds ratio Upper bound (95%)
Intercept	-1.512	0.355	18.156	<0.0001	-2.208	-0.817			
children in HH	0.904	0.301	9.037	0.003	0.315	1.493	2.469	1.370	4.450
hl1	0.033	0.016	4.452	0.035	0.002	0.064	1.034	1.002	1.067
hl2	-0.027	0.012	4.915	0.027	-0.051	-0.003	0.973	0.950	0.997
hl3	-0.004	0.016	0.049	0.825	-0.035	0.028	0.996	0.966	1.028

Model parameters

The model shows that the hl3 variable is not significant at the 95% level, but is significant at the 90% level. In this analysis, I'll keep it.

Besides that, the coefficients for children in HH, and the hl variable are positive; the coefficients for h2&h3 are negative, which aligns with the company's original hypothesis.

Scoring Holdout Data

The score function maps observed predictor variables into a propensity-to-buy score.

		Actual Response Rate				Avg Response Rate			Calculate average estimates			
intercept	children in HH	h1	h2	h3	actual response rate in the estimation-list	avg, score	avg prob	avg lift	avg marginal effect of children	avg marginal effect of h1	avg marginal effect of h2	avg marginal effect of h3
-1.512	0.904	0.033	-0.027	-0.004	0.31147541	-0.915	0.299	0.960	0.176	0.007	-0.005	-0.001
id	children in HH	h1	h2	h3	y	Score	Probability	Lift	Marginal effect of children in HH	Marginal effect of h1	Marginal effect of h2	Marginal effect of h3
8	1	47	40	0	1	-0.125	0.46888861	1.505379219	0.225	0.008	-0.00676362	-0.000884984
9	0	45	20	26	0	-0.644	0.34426162	1.105260994	0.204	0.008	-0.006131166	-0.000802231
10	0	11	0	15	0	-1.198	0.23180655	0.744221043	0.161	0.006	-0.004836377	-0.000632814
11	0	17	10	0	0	-1.216	0.22865034	0.734087949	0.159	0.006	-0.004790127	-0.000626763
12	0	9	0	0	0	-1.212	0.22940744	0.736518631	0.160	0.006	-0.004801271	-0.000628221
13	0	22	10	13	1	-1.095	0.25066327	0.804761036	0.170	0.006	-0.005101426	-0.000667495
14	0	35	35	13	0	-1.340	0.20756068	0.666379012	0.149	0.005	-0.004467196	-0.000584509
20	0	14	0	0	0	-1.045	0.26026489	0.835587281	0.174	0.006	-0.005228964	-0.000684182
21	1	17	0	13	1	-0.087	0.47830697	1.535617114	0.226	0.008	-0.006777127	-0.000886751
23	0	12	0	0	0	-1.111	0.24760636	0.794946749	0.168	0.006	-0.00505977	-0.000662044
27	1	6	10	0	0	-0.680	0.33631168	1.079737511	0.202	0.007	-0.006062196	-0.000793206
28	1	26	0	0	1	0.260	0.5646593	1.812853535	0.222	0.008	-0.006676358	-0.000873566

Calculate from model

$$\frac{\text{Exp(score)}}{1+\text{Exp(score)}}$$

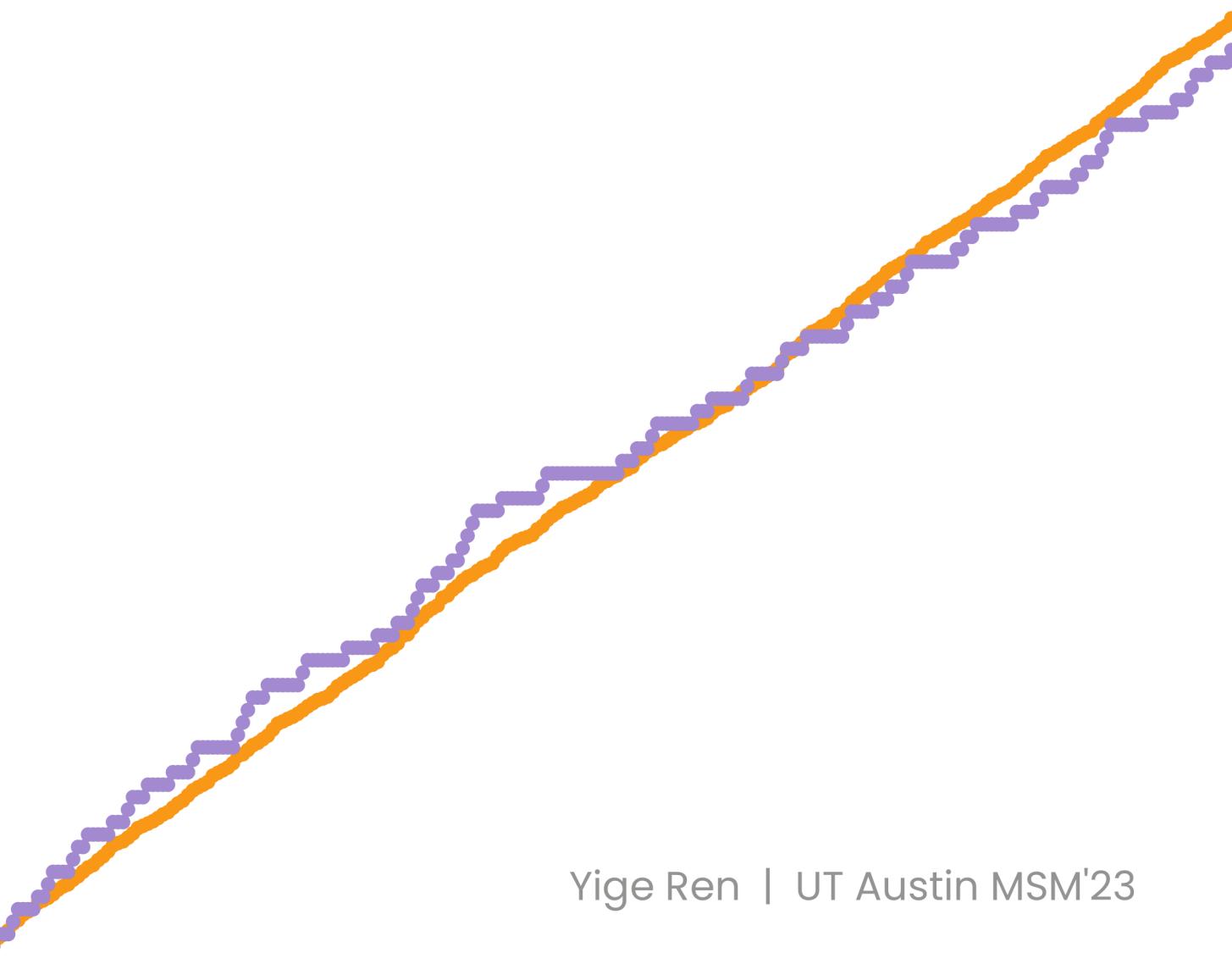
$$\frac{\text{Prob}}{\text{Actual Response Rate}}$$

$$\frac{\partial \Pr_i}{\partial x_i} = \beta \Pr_i (1 - \Pr_i)$$

Model Assessment

From the graph, I think the model can be considered a good fit since the expected sales align well with actual sales.

■ Expected Sales ■ Actual Sales



id	children in HH	hl1	hl2	hl3	y	Score	Probability	Lift	Expected sales		Actual	Total expected	Total actual
8	1	47	40	0	1	-0.1246	0.4689	1.5054	0.4689	1.0000	0.4689	1.0000	
9	0	45	20	26	0	-0.6444	0.3443	1.1053	0.3443	0.0000	0.8132	1.0000	
10	0	11	0	15	0	-1.1981	0.2318	0.7442	0.2318	0.0000	1.0450	1.0000	
11	0	17	10	0	0	-1.2159	0.2287	0.7341	0.2287	0.0000	1.2736	1.0000	
12	0	9	0	0	0	-1.2117	0.2294	0.7365	0.2294	0.0000	1.5030	1.0000	
13	0	22	10	13	1	-1.0951	0.2507	0.8048	0.2507	1.0000	1.7537	2.0000	
14	0	35	35	13	0	-1.3397	0.2076	0.6664	0.2076	0.0000	1.9612	2.0000	
20	0	14	0	0	0	-1.0446	0.2603	0.8356	0.2603	0.0000	2.2215	2.0000	
21	1	17	0	13	1	-0.0868	0.4783	1.5356	0.4783	1.0000	2.6998	3.0000	
23	0	12	0	0	0	-1.1114	0.2476	0.7949	0.2476	0.0000	2.9474	3.0000	
27	1	6	10	0	0	-0.6798	0.3363	1.0797	0.3363	0.0000	3.2837	3.0000	
28	1	26	0	0	1	0.2601	0.5647	1.8129	0.5647	1.0000	3.8484	4.0000	
32	0	30	15	0	1	-0.9174	0.2855	0.9166	0.2855	1.0000	4.1339	5.0000	
33	1	20	10	0	0	-0.2120	0.4472	1.4358	0.4472	0.0000	4.5811	5.0000	
35	0	24	15	0	0	-1.1179	0.2464	0.7911	0.2464	0.0000	4.8275	5.0000	
36	0	15	15	0	0	-1.4186	0.1949	0.6257	0.1949	0.0000	5.0224	5.0000	
38	1	31	15	0	1	0.0198	0.5049	1.6211	0.5049	1.0000	5.5273	6.0000	
39	0	30	35	13	0	-1.5068	0.1814	0.5825	0.1814	0.0000	5.7087	6.0000	
41	0	8	0	15	1	-1.2984	0.2144	0.6885	0.2144	1.0000	5.9232	7.0000	
43	0	30	15	0	1	-0.9174	0.2855	0.9166	0.2855	1.0000	6.2087	8.0000	
46	1	14	15	0	0	-0.5483	0.3663	1.1759	0.3663	0.0000	6.5749	8.0000	
47	0	14	0	0	0	-1.0446	0.2603	0.8356	0.2603	0.0000	6.8352	8.0000	
48	0	33	45	0	0	-1.6319	0.1636	0.5251	0.1636	0.0000	6.9988	8.0000	
49	1	15	15	0	1	-0.5149	0.3741	1.2009	0.3741	1.0000	7.3728	9.0000	
50	0	25	10	0	1	-0.9486	0.2792	0.8962	0.2792	1.0000	7.6520	10.0000	
51	1	11	10	15	0	-0.5660	0.3622	1.1627	0.3622	0.0000	8.0141	10.0000	
53	0	25	0	0	1	-0.6770	0.3369	1.0817	0.3369	1.0000	8.3511	11.0000	
55	0	18	20	0	0	-1.4541	0.1894	0.6080	0.1894	0.0000	8.5404	11.0000	
57	1	17	10	26	0	-0.4046	0.4002	1.2849	0.4002	0.0000	8.9406	11.0000	
60	0	33	15	0	0	-0.8171	0.3064	0.9836	0.3064	0.0000	9.2470	11.0000	
61	1	37	35	26	0	-0.4153	0.3976	1.2766	0.3976	0.0000	9.6446	11.0000	
64	1	27	10	26	1	-0.0705	0.4824	1.5487	0.4824	1.0000	10.1270	12.0000	
66	0	13	15	0	0	-1.4854	0.1846	0.5927	0.1846	0.0000	10.3116	12.0000	
69	0	5	15	13	0	-1.7989	0.1420	0.4558	0.1420	0.0000	10.4536	12.0000	

Cutoff for Targeting

The grocery and meal delivery business is notorious for low margins and high customer churn. Assume the costs & revenue are as follows. Based on the marginal cost rule, I will determine the cut-off probability of offers.



CLV

Orange Apron estimates the average customer lifetime value to be \$13.50.



Solicitation

Assume a solicitation cost of \$3.



List Rental Cost

Assume the list owner charges a rental cost of \$1 per household.

Cutoff for Targeting



Marginal Response Probability:

$$\frac{\text{CLV}}{\text{Solicitation cost}} = 13.5 / 3 = 0.2222$$

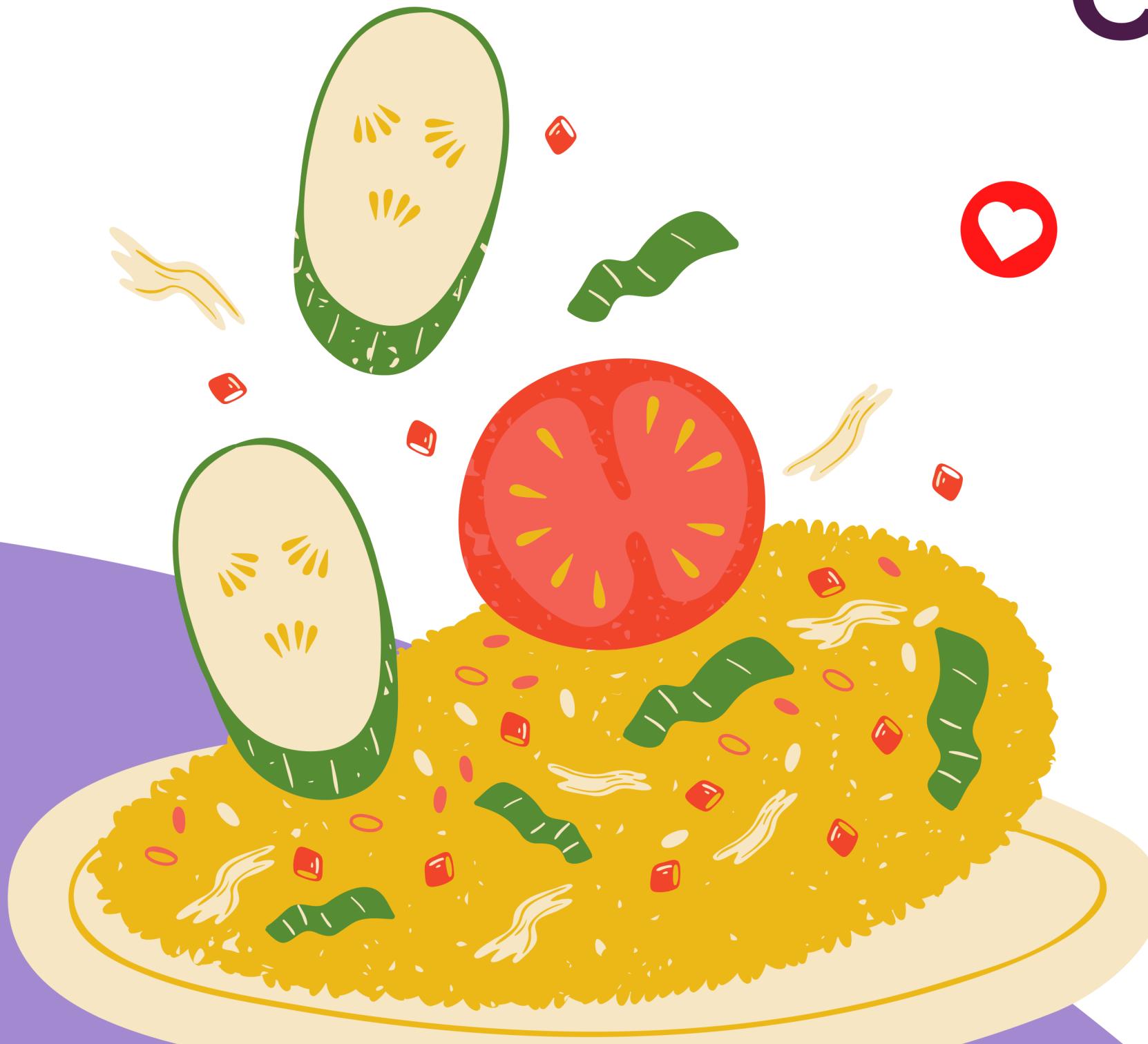
Target=1 & y=1: Profit=13.5-1-3=9.5
 Target=1 & y=0: Profit=-1-3=-4
 Target=0: Profit=-1=-1

If Prob > 0.2222



id	children	hl1	hl2	hl3	y	Score	Probability	Lift	Targeted	Profit
8	1	47	40	0	1	-0.1246065	0.46888861	1.50537922	1	9.5
9	0	45	20	26	0	-0.64436	0.34426162	1.10526099	1	-4
10	0	11	0	15	0	-1.1981384	0.23180655	0.74422104	1	-4
11	0	17	10	0	0	-1.2159478	0.22865034	0.73408795	1	-4
12	0	9	0	0	0	-1.2116601	0.22940744	0.73651863	1	-4
13	0	22	10	13	1	-1.095078	0.25066327	0.80476104	1	9.5
14	0	35	35	13	0	-1.3396922	0.20756068	0.66637901	0	-1
20	0	14	0	0	0	-1.0445922	0.26026489	0.83558728	1	-4
21	1	17	0	13	1	-0.0868266	0.47830697	1.53561711	1	9.5
23	0	12	0	0	0	-1.1114194	0.24760636	0.79494675	1	-4
27	1	6	10	0	0	-0.6797743	0.33631168	1.07973751	1	-4

Cutoff for Targeting



- Summing up profits, the expected profits using the targeting strategy are \$63.5
- If sending out offers without the targeting strategy, the expected profits are \$25
- By applying scoring with the logit model, the profits were improved by \$88.5, indicating the monetary value of scoring is \$88.5.

Thank you!

Welcome to contact yige.ren@utexas.edu

