

Adaptive Customization

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Screening 8,000 electronic tablets at Amazon.com

Tablets display

Amazon.com: tablet - Search

Secure | https://www.amazon.com/s/ref=sr_l_tn_computers?rh=k%3Atablets%2Cn%3A17228%2Cn%3A541966%2Cn%3A13896617011%2Cn%3A1232597011&keywords=tablet&ie=UTF8&qid=1528609439&pf_rd_p=computers

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Tablet Display Size

- ☐ Under 7 inches
- ☐ 7 to 7.9 inches
- ☐ 8 to 8.9 inches
- ☐ 9 to 9.9 inches
- ☐ 10 to 10.9 inches
- ☐ 11 inches & Up

Avg. Customer Review

- ☒ 4 stars & up
- ☐ 3 stars & up
- ☐ 2 stars & up
- ☐ 1 star & up

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★★★★☆ 8,452 ☒ prime

Ad feedback

Tablet PC Operating System: Android | Windows | Apple | Fire

Best Seller

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★★★★☆ 35,351

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~~\$99.99~~ ☒ prime | FREE One-Day

★★★★☆ 8,424

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Amazon's Choice

Fire 7 Tablet with Alexa, 7" Display, 8 GB, Black - with Special Offers

~~\$39.99~~ \$49.99 ☒ prime

★★★★☆ 33,351

Adaptive customization

- Observe the first screening feature used by a shopper (e.g., electronic tablet)
- Predict the sequence of features the shopper is likely to use to *further* screen alternatives
- Repeat the prediction after the shopper selects each additional feature
- Use each prediction to customize the:
 - Menu (on the left)
 - Display (on the right)
 - Recommended alternatives

Customization and recommendation: Ansari and Mela (2003), Linden et al. (2003), Das et al. (2007), Hauser et al.(2009, 2014), Koren and Bell (2015), Dzyabura and Hauser (2018)

Lexicographic screening rules: Bröder (2000), Bröder and Schiffer (2003), Slovic (1975), Drolet and Luce (2004), Kohli and Jedidi (2007) and Yee et al. (2007), Aribagh et al. (2017), Hoffrage and Kleinbolting (1991), Bröder (2000), Gigerenzer, and Dieckmann, Dippold and Dietrich (2009)

Presentation structure

Model

Offline screening model

Online Customization

Application: Choice of electronic tablets

Initial customization

Customization after first feature selection

Customization after second feature selection

Conclusion

Model

Offline and online components

Offline screening model

- Identify latent segments, each using the same screening process
 - allow uncertainty in screening sequence within and across segments
 - estimate using screening and/or choice data

Online customization

- Observe feature sequence selected by a shopper
- Use Bayes' rule used to:
 - update segment membership probabilities for the shopper
 - predict which features a shopper is most likely to use next
 - recommend products targeting the shopper

Model of the screening process (Offline)

Probabilistic lexicographic rule:

$u_i = v_i + \epsilon_i$: random utility of feature i

On a choice occasion :

- If the features sequence, say $(1, \dots, m)$, is observed

$$p(u_1 > \dots > u_m) = \prod_{i=1}^{m-1} \frac{e^{v_i}}{\sum_{j=i}^m e^{v_j}}$$

- If only choice is observed use EBA

Allow different segment-level utilities

$$u_{is} = v_{is} + \epsilon_{is}, s = 1, \dots, S$$

Estimate latent segments sizes $p(s)$ and v_{is} values

Method for adaptive customization (Online)

A shopper uses a first screening feature σ_1 with probability

$$p(\sigma_1|s) = \frac{e^{v_{\sigma_1 s}}}{\sum_{j=1}^m e^{v_{\sigma_j s}}}.$$

The probability of the shopper belonging to segment s is

$$p(s|\sigma_1) = \frac{p(\sigma_1|s)p(s)}{\sum_{s=1}^S p(\sigma_1|s)p(s)}, s = 1, \dots, S.$$

Method for adaptive customization (Online)

Predict the next features σ_2 using

$$p(\sigma_2|\sigma_1) = \sum_{s=1}^S p(\sigma_2|s) \cdot p(s|\sigma_1)$$

where

$$p(\sigma_2|s) = \frac{e^{v_{\sigma_2 s}}}{\sum_{j=r}^m e^{v_{\sigma_j s}}}$$

with $m - r + 1$ the number of remaining features.

Predict the set of products the shopper is most likely to choose.

Repeat the procedure after selection of a new feature.

Application: Choice of electronic tablets

Tablet computers



- Choice experiment with 137 subjects
- 15 choice sets/subject; 3 alternatives per choice set.
- Design factors
 - (1) Brand name: iPad, Galaxy, Surface, Nexus and Kindle
 - (2) Screen size: 7 inches, 8 inches, 9 inches and 10 inches
 - (3) Hard drive capacity: 16GB, 32GB, 64GB, and 128GB
 - (4) RAM: 1GB, 2GB and 4GB
 - (5) Battery life: 7 hours, 8 hours and 9 hours
 - (6) Price: \$169, \$199, \$299, \$399 and \$499

To determine the number of segments, we used

- a nonparametric approach (Dirichlet process prior)
- a parametric approach (latent class)

We used Hamiltonian Monte Carlo for calibration

Both approaches resulted in a 5 segment solution

We used a set of 280 undominated products to simulate the adaptive customization

Feature importance ranks for each segment

Rank	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
1	\$169	iPad	128GB HD	\$169	\$169
2	\$199	\$169	64GB HD	\$199	\$199
3	\$299	\$199	32GB HD	\$299	\$299
4	\$399	\$299	iPad	4GB RAM	\$399
5	128GB HD	\$399	2GB RAM	\$399	Kindle
6	32GB HD	Galaxy	4GB RAM	2GB RAM	128GB HD
7	64GB HD	7" screen	9" screen	Galaxy	iPad
8	10" screen	9" screen	Galaxy	128GB HD	64GB HD
9	8" screen	4GB RAM	Nexus	64GB HD	32GB HD
10	9" screen	10" screen	Surface	32GB HD	9h battery
11	7" screen	8" screen	Kindle	10" screen	8h battery
12	Galaxy	128GB HD	\$169	Surface	4GB RAM
13	iPad	64GB HD	\$199	8" screen	2GB RAM
14	Surface	Surface	\$299	9h battery	Surface
15	Nexus	9h battery	9h battery	Kindle	10" screen
16	9h battery	Nexus	8h battery	Nexus	Nexus
17	8h battery	2GB RAM	8" screen	iPad	9" screen
18	4GB RAM	8h battery	7" screen	8h battery	8" screen
19	2GB RAM	Kindle	\$399	9" screen	7" screen
20	Kindle	32GB HD	10" screen	7" screen	Galaxy
Segment size	0.29	0.18	0.29	0.15	0.09

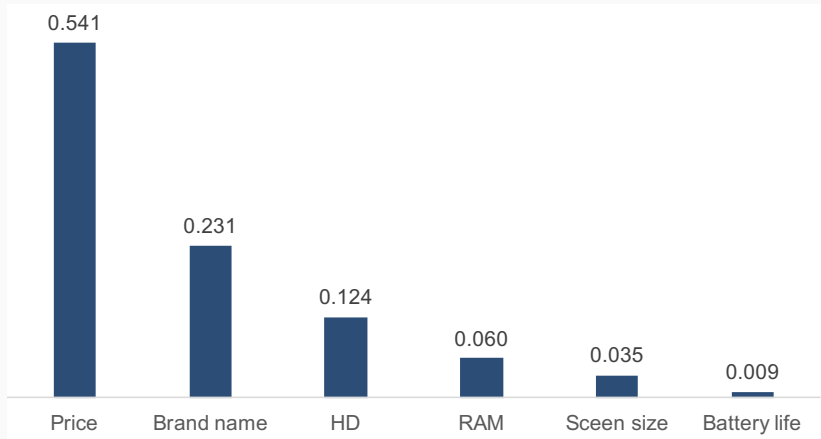
Initial customization

First-step screening by attributes and segments

Attribute	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
Price	0.94	0.07	0.25	0.83	0.60
Brand	0.00	0.86[†]	0.19	0.01	0.28
Hard drive	0.04	0.02	0.34	0.01	0.08
RAM	0.00	0.01	0.13	0.12	0.01
Screen size	0.01	0.04	0.07	0.01	0.01
Battery life	0.00	0.00	0.02	0.01	0.01

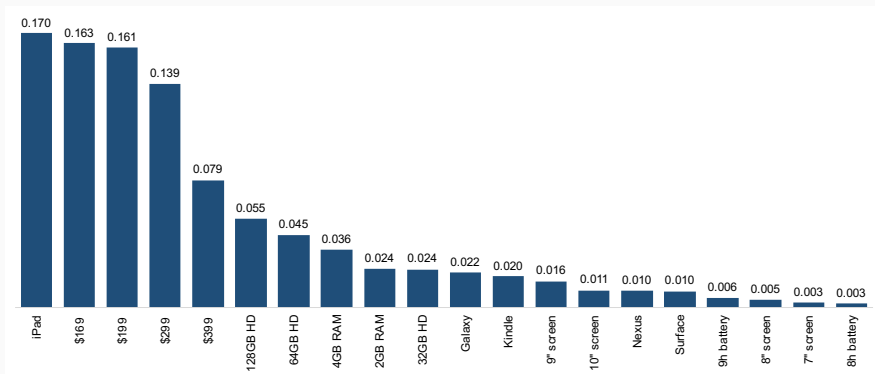
[†] p=0.84 for iPad

Unconditional first-click probabilities for attributes



Initial attribute ordering in menu

Unconditional first-click probabilities for features $p(\sigma(1))$



Highlighted features

Recommended tablets for a new shopper

Across segments: offer \$169 tablet with 1GB and

Brand	Battery life	Hard drive	Screen size
Galaxy	7h	128GB	9" and 10"
Galaxy	9h	16GB	10"
iPad	7h	16GB	7," 9" and 10"
Nexus	7h	128GB	9" and 10"
Surface	7h	16GB	9" and 10"

Customization after first feature selection

Segment membership probability after first click $p(s|\sigma(1))$

	Posterior membership probabilities					Entropy	
	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	After click on feature	% reduction
\$199	0.53	0.02	0.13	0.23	0.09	1.23	19%
\$169	0.53	0.02	0.13	0.23	0.09	1.24	19%
\$299	0.50	0.02	0.14	0.23	0.11	1.28	16%
\$399	0.34	0.04	0.19	0.28	0.15	1.45	5%
iPad	0.00	0.89	0.09	0.00	0.03	0.42	72%
7" screen	0.21	0.56	0.14	0.05	0.04	1.22	20%
Nexus	0.00	0.01	0.98	0.00	0.00	0.11	93%
Surface	0.03	0.01	0.83	0.06	0.07	0.65	57%
128GB HD	0.07	0.03	0.81	0.02	0.07	0.72	53%
64GB HD	0.09	0.03	0.80	0.02	0.06	0.75	51%
9" screen	0.05	0.15	0.78	0.00	0.01	0.71	54%
2GB RAM	0.00	0.00	0.68	0.30	0.02	0.72	53%
9h battery	0.04	0.04	0.67	0.12	0.12	1.05	31%
Galaxy	0.02	0.22	0.66	0.02	0.07	0.96	37%
32GB HD	0.19	0.00	0.66	0.04	0.11	0.96	37%
4GB RAM	0.00	0.06	0.59	0.33	0.01	0.93	39%
Kindle	0.00	0.00	0.42	0.01	0.57	0.73	52%
8" screen	0.26	0.32	0.39	0.02	0.00	1.19	22%
8h battery	0.13	0.08	0.27	0.23	0.29	1.51	1%
10" screen	0.14	0.24	0.34	0.21	0.07	1.49	2%
Membership priors	0.29	0.18	0.29	0.15	0.09	0.97	37%
Prior entropy	1.53						

Second feature selection probability $p(\sigma(2)|\sigma(1))$

First feature	Second attribute						Price, Brand or Hard Drive
	Price	Brand	Screen size	Hard Drive	RAM	Battery life	
Galaxy	0.90	—	0.02	0.05	0.02	0.00	0.95
iPad	0.43	—	0.27	0.14	0.09	0.01	0.56
Surface	0.34	—	0.10	0.38	0.15	0.02	0.72
Kindle	0.33	—	0.10	0.39	0.15	0.02	0.72
Nexus	0.33	—	0.10	0.39	0.15	0.02	0.72
\$399	0.85	0.04	0.02	0.05	0.04	0.01	0.94
\$299	0.81	0.04	0.02	0.06	0.06	0.01	0.92
\$199	0.76	0.05	0.03	0.07	0.08	0.01	0.88
\$169	—	0.08	0.16	0.47	0.25	0.04	0.55
8h battery	0.48	0.13	0.06	0.21	0.10	0.01	0.82
9h battery	0.36	0.15	0.08	0.29	0.12	—	0.80
4GB RAM	0.47	0.18	0.08	0.26	—	0.01	0.91
2GB RAM	0.40	0.14	0.08	0.29	0.07	0.02	0.83

Recommended tablets after the shopper selects iPad

Across segments, offer iPad with 7 hr battery and

Price	RAM	Hard drive	Screen size
\$299	2GB	128GB	9"
\$199	1GB	128GB	9"
\$169	1GB	16GB	7", 8", 9" and 10"

Customization after second feature selection

Recommended tablets after the shopper selects iPad and \$299

Across segments, offer iPad at \$299 with the following features

RAM	Battery life	Hard drive	Screen size
4GB	8h	32GB	10"
4GB	8h	32GB	7"
2GB	7h	128GB	8", 9" and 10"
1GB	9h	64GB	9" and 10"
1GB	8h	128GB	8", 9" and 10"

Conclusion

Conclusion

We developed an offline/online model to

- predict the sequence of features the shopper is likely to use to *further* screen alternatives
- repeat the prediction after the shopper selects each additional feature
- use each prediction to customize the online platform

Future directions

- Test the mechanism performance in a real setting
- Use other firm objectives (e.g. profit maximization)
- Apply to other product categories (e.g. music)