Search Costs vs. User Satisfaction on Mobile

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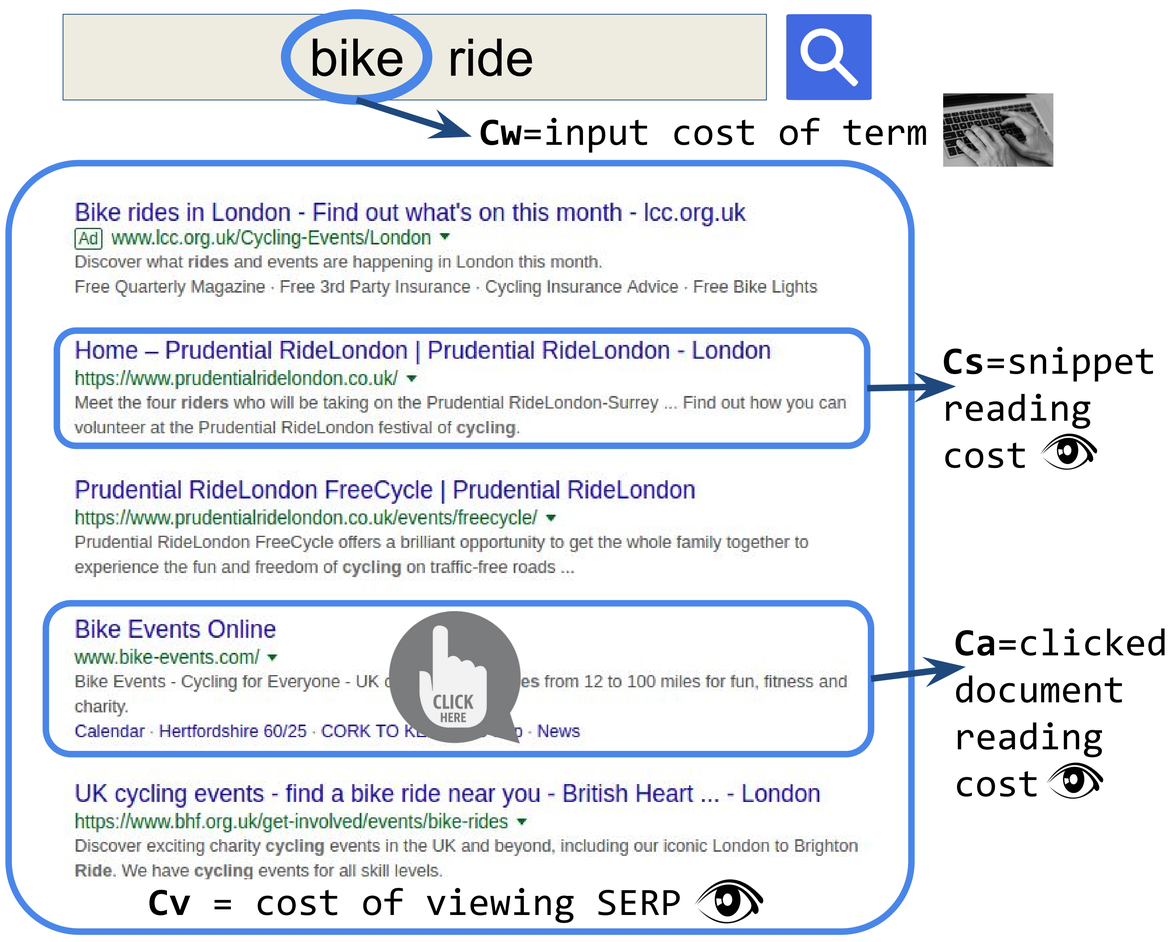
COST BENEFIT MODELS 101 [1][2]



Other Variables

- **W** = Number of words in query
- **Q** = Number of queries input by user
- **A** = Number clicked documents
- **S** = Number of viewed snippets
- **V** = Number of SERPs viewed per query

Query Cost-Benefit Model [1]

Total Cost $\mathcal{C}(\mathbf{W}) = \mathbf{W}.C_W$
Total Benefit $\mathcal{B}(\mathbf{W}) = k.\log_\alpha(\mathbf{W} + 1)$
NET PROFIT $\boldsymbol{\pi}(\mathbf{W}) = \mathcal{B}(\mathbf{W}) - \mathcal{C}(\mathbf{W})$

*Where **k** is a scaling factor and **α** is diminishing returns of typing subsequent words*

Search Cost-Benefit Model [2]

Total Cost $\mathcal{C}(\mathbf{Q},\mathbf{V},\mathbf{S},\mathbf{A}) = (C_W + C_V.\mathbf{V} + C_S.\mathbf{S} + C_A.\mathbf{A}).\mathbf{Q}$
Total Benefit $\mathcal{B}(Q, A) = k.\mathbf{Q}^{\alpha}.\mathbf{A}^{\beta}$
NET PROFIT $\boldsymbol{\pi}(W) = \mathcal{B}(Q, A) - \mathcal{C}(Q, V, S, A)$

*Where **k** is a scaling factor, **α** and **β** are user's frequency of issuing multiple queries and reading multiple documents respectively.*

RESEARCH QUESTIONS AND CONTRIBUTIONS

- How is **net benefit for above models correlated with user satisfaction**? Does higher net benefit always yield a satisfied user.
  - While **query cost-benefit models** are **strongly correlated** with user satisfaction, **search cost-benefit models** have **weaker correlation.**
- How do the **coefficients in above models vary for search sessions on mobile**? At present, coefficients are determined from desktop based user studies.
  - **Coefficients for mobile differ from desktop,** more for query cost benefit models than search cost-benefit models.

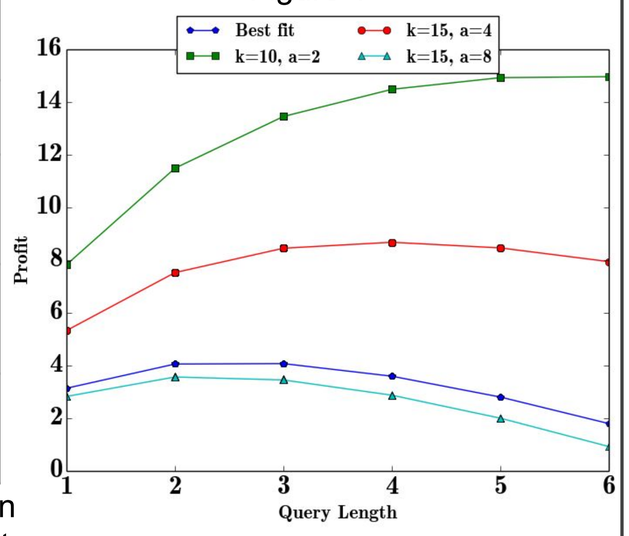
RESULTS

Query Cost-Benefit Model

$k\mapsto$ / $\alpha\downarrow$	10	15	20
2	-0.10	-0.14	-0.15
4	0.312*	-0.009	-0.10
6	0.271*	0.27*	-0.02
8	0.256*	0.312*	-0.09

Table 1: Pearson Correlation between net profit and satisfaction for different values of k and α

Figure 1



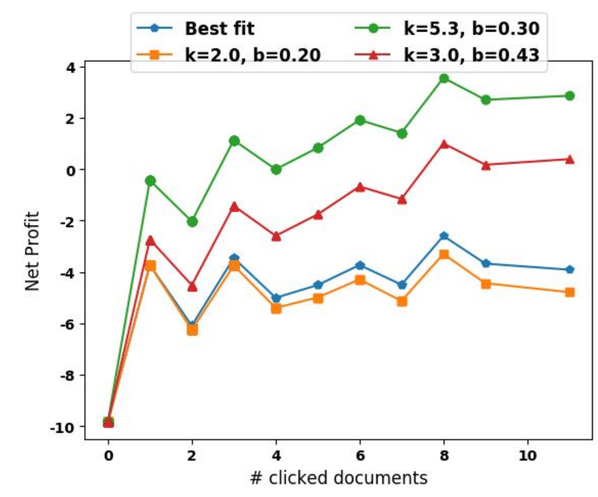
- We can estimate parameters k and α by **minimizing squared loss** between satisfaction labels obtained from a lab study and net profit.
- Figure 1 is the distribution of Net Profit for different query lengths with different values of k and α.
- Parameter values C_W = 2.18, k = 8.5 and α = 3.0 yield best fit on our data and are highly correlated with SERP level satisfaction labels.

Search Cost-Benefit Model

$k\mapsto$ / $\beta\downarrow$	2	5	10
0.03	0.16*	0.14*	0.10*
0.30	0.17*	0.13*	0.09*
0.43	0.16*	0.12	0.08
1.00	0.11	0.08	0.07

Table 2: Pearson Correlation between net profit and satisfaction for different values of k and β

Figure 2



- Figure 2 is the distribution of Net Profit with number of clicked documents for different values of k and β.
- On minimizing the squared difference between satisfaction and net profit, we obtain k = 2.0 and β = 0.30.
- Pearson Correlation between SERP satisfaction labels and net profit obtained by search cost-benefit model is lower than query cost-benefit model.

REFERENCES

1. L. Azzopardi and G. Zuccon. An analysis of the cost and benefit of search interactions. In Proc. ICTIR, pages 59–68. ACM, 2016
2. L. Azzopardi. Modelling interaction with economic models of search. In Proc. SIGIR. ACM, 2014