

The Size Conundrum

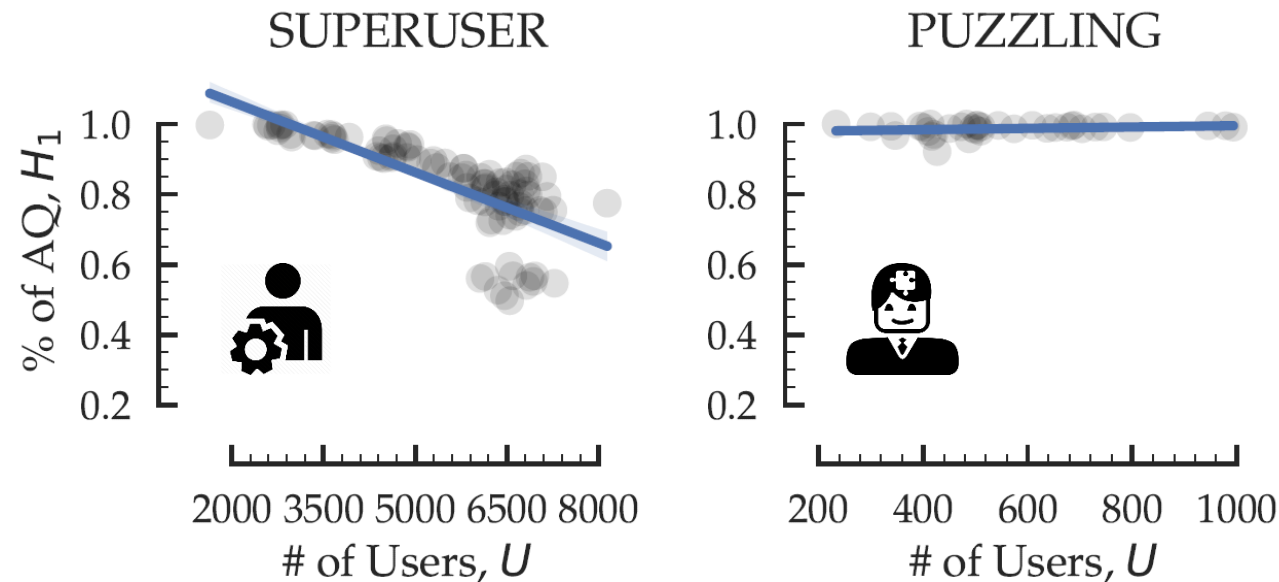
Why Online Knowledge Markets Can Fail at Scale

Himel Dev, Chase Geigle, Qingtao Hu, Jiahui Zheng, Hari Sundaram
University of Illinois at Urbana–Champaign



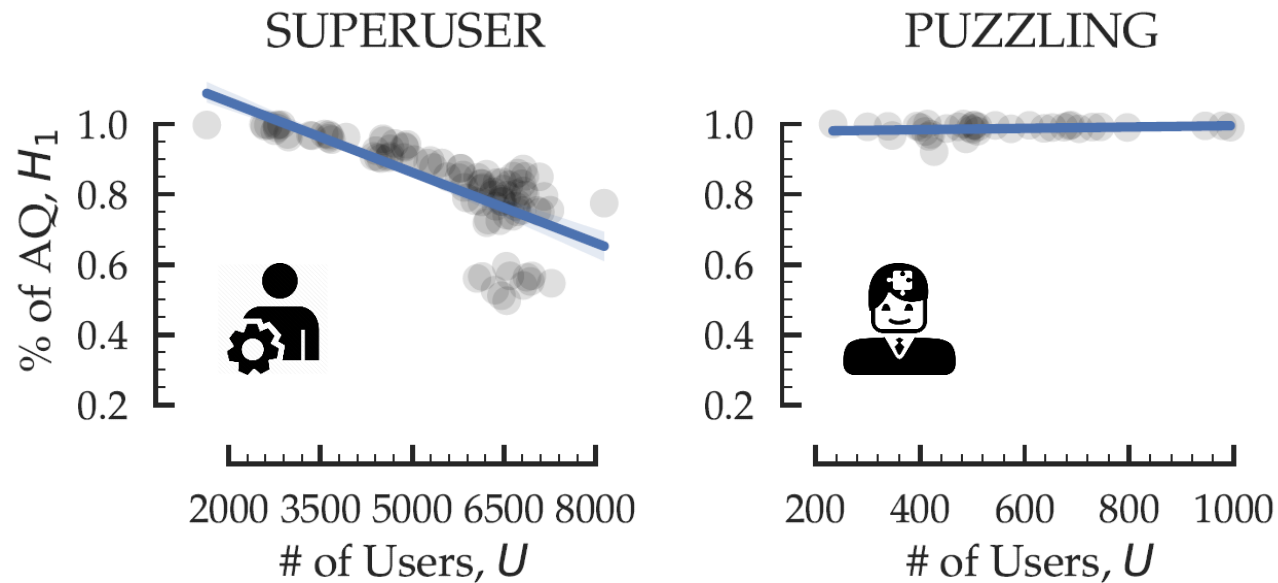
Let's examine user growth at two StackExchanges: **superuser** & **puzzling**.

Why is superuser **failing at scale**, while puzzling continues to thrive?



What should you do as a social media operator?

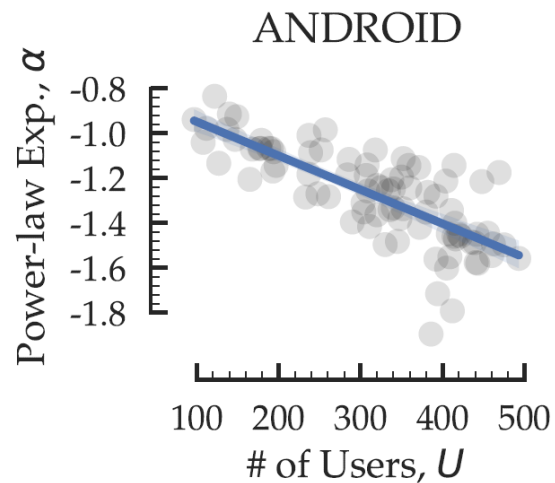
Should you **expand** your platform, **or not**?



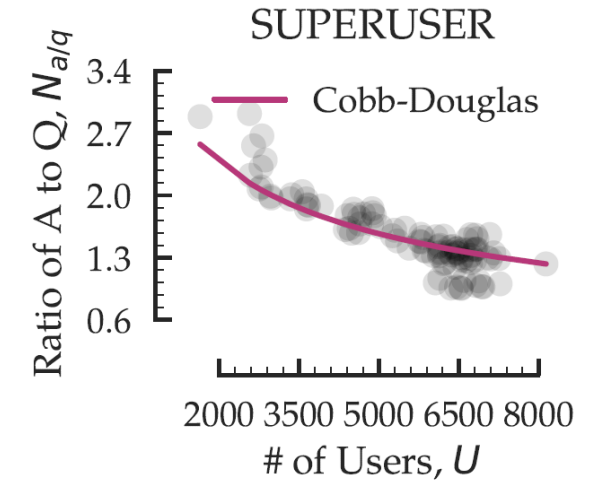
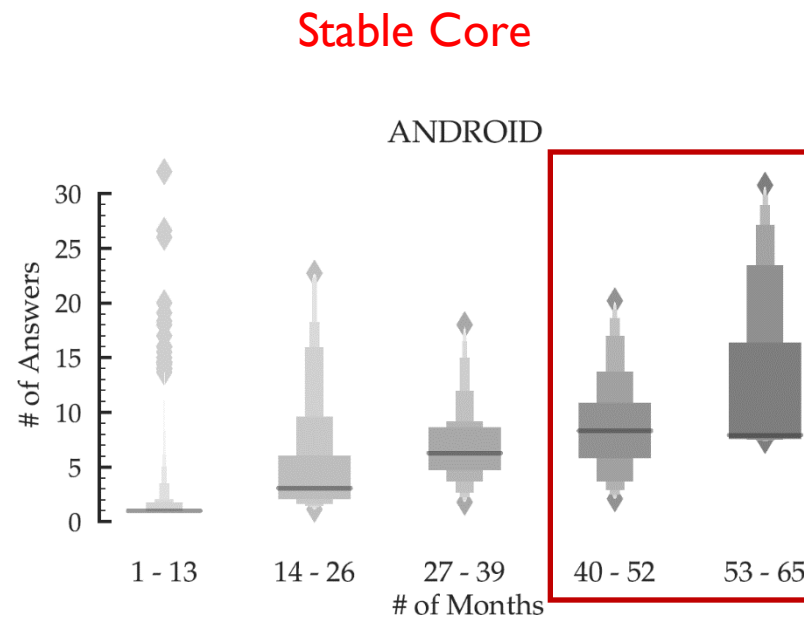
Our key idea: **social media** platforms are **markets** where participants exchange information

Findings

Our analysis provides three critical insights: **stable core**, **size dependent distribution**, and **diseconomies of scale**



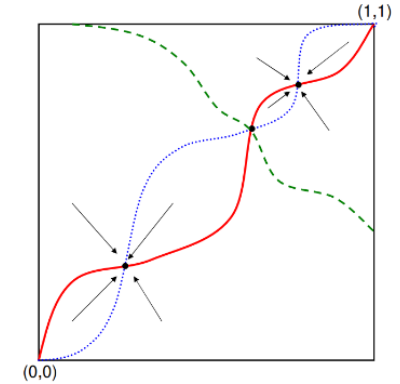
Size Dependent Distribution



Diseconomies of Scale

Related Work

1. Evolution of two-sided markets. Ravi Kumar, Yury Lifshits, and Andrew Tomkins. WSDM (2010).



2. Knowledge Market Design: A Field Experiment at Google Answers. Yan Chen, Teck-Hua Ho, and Yong-Mi Kim. Journal of Public Economic Theory (2009).

Table 4: Determinants of Answer Length (Effort)

	Dependent Variable: Word Count		
	(1) IPL	(2) GA	(3) All
Price	7.472 (23.035)	13.097 (2.545)***	12.575 (2.128)***
Tip	16.862 (21.164)	25.519 (19.357)	27.115 (13.796)*
Reputation	1,368.709 (434.286)***	1,073.285 (613.795)*	1,143.625 (413.810)***
Experience	-0.244 (0.128)*	-0.136 (0.126)	-0.168 (0.095)*
Constant	-5,083.371 (2,011.381)**	-4,259.175 (2,687.905)	-4,448.396 (1,801.455)**
Observations	75	125	200



Motivation and Problem Statement

Modeling Knowledge Markets

Knowledge Market Characteristics

Knowledge Market Failures

Implications and Summary



Market



Information Market

Social media enable users to **exchange** information

Does the sun rotate?

As implied from the question, does the sun rotate? If so, do other stars not including the sun also rotate? Would there be any consequences if the sun and other stars didn't rotate? Me and my friends have differing views on this, and would like some clarification. Thanks!

asked 5 years ago
viewed 3,735 times
active 4 years ago

Linked

- 54 Proof that the Earth rotates?
- 34 Have we figured out how to analyze turbulent fluids?
- 5 How is the Hanbury-Brown and Twiss effect used to measure the size of stars?

Related

- 6 Why is the sun so dense?
- 6 What frame(s) of reference are used to measure the rotation of the Sun around the galaxy?
- 6 Reverse Sun position algorithm?
- 4 Does the Sun produce audible sound?
- 6 Does the Earth actually rotate around the sun?
- 6 Why anticlockwise movement is present in the whole universe
- 14 How long does a positron last in the Sun's core?
- 1 Does the sun have angular momentum?
- 0 Why do all visible stars in the sky appear bluish, while our Sun is yellow?
- 0 What will happen if the nuclear reactions in the Sun stop suddenly?

4 Answers

Yes, the sun and nearly all other stars do rotate.

One can see the rotation of the sun by looking at the motion of sunspots on its surface. Over time, the sunspots will move across the sun's surface - proof of its rotation. Furthermore, the rate of the sun's rotation is not constant throughout the sun; it is higher near the equator and slower near the poles.

Problem Statement

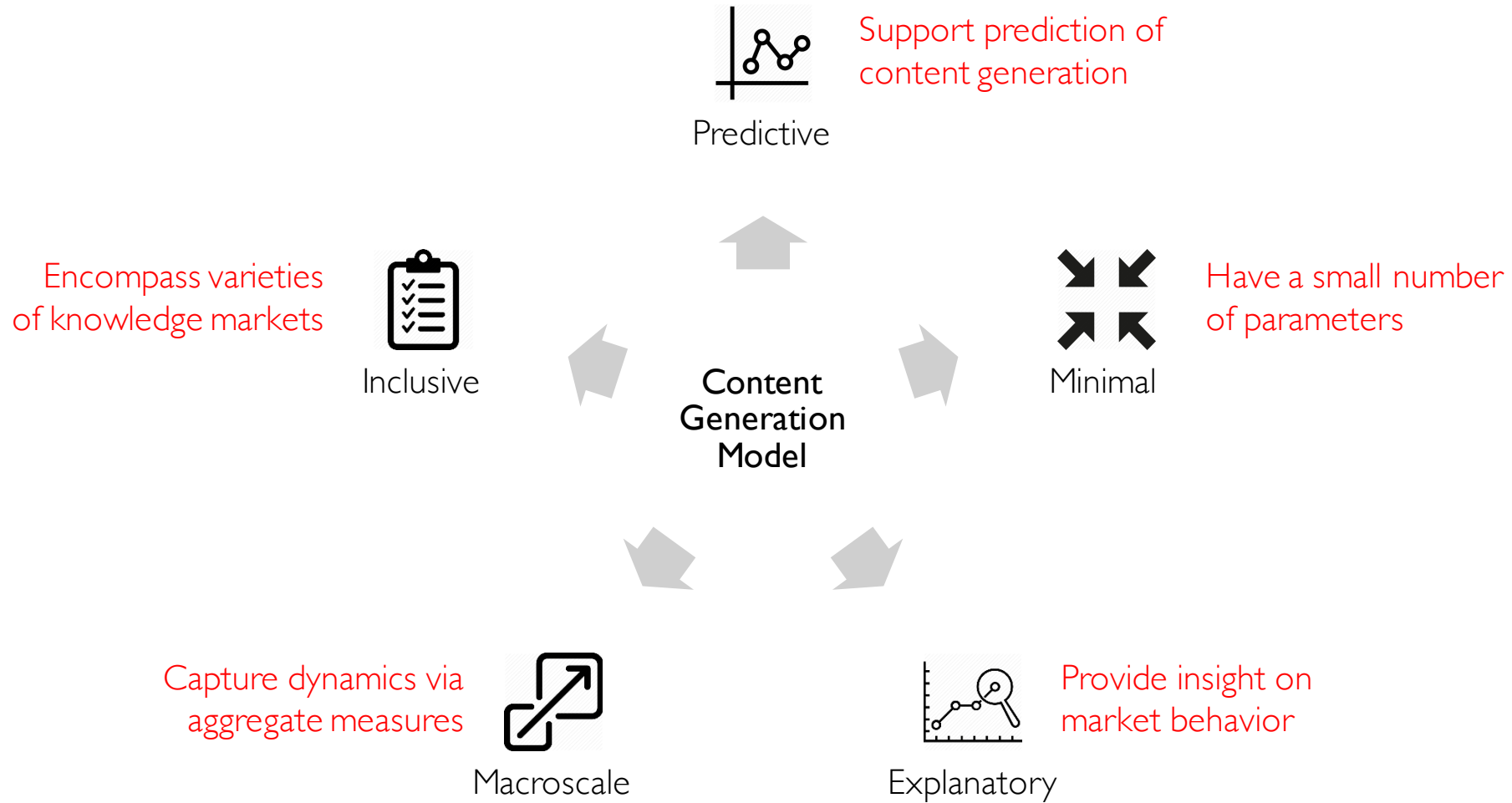
We concentrate on a particular type of social media platform—community question answering (CQA) websites that we interpret as **knowledge markets**.

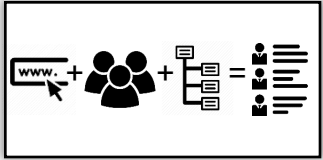
Our **goal** is to design a model for **content generation** in knowledge markets, and reason about market **sustainability**.

What factors drive the production and consumption processes?

How can we predict future production and consumption?

Modeling Desiderata





Motivation and
Problem Statement

Modeling Knowledge Markets

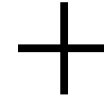
Knowledge Market
Characteristics

Knowledge Market
Failures

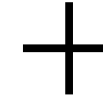
Implications and
Summary



Social Media
Platform



User
Participation



Content
Dependency



Social Media
Content

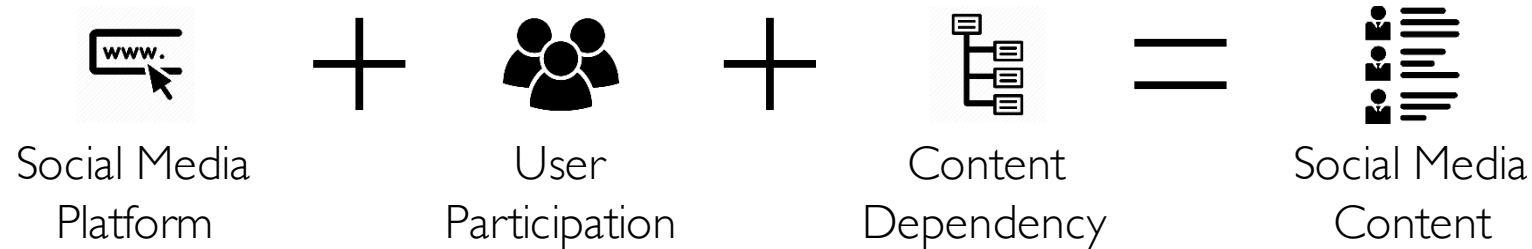
Content Generation in StackExchange



Model Overview

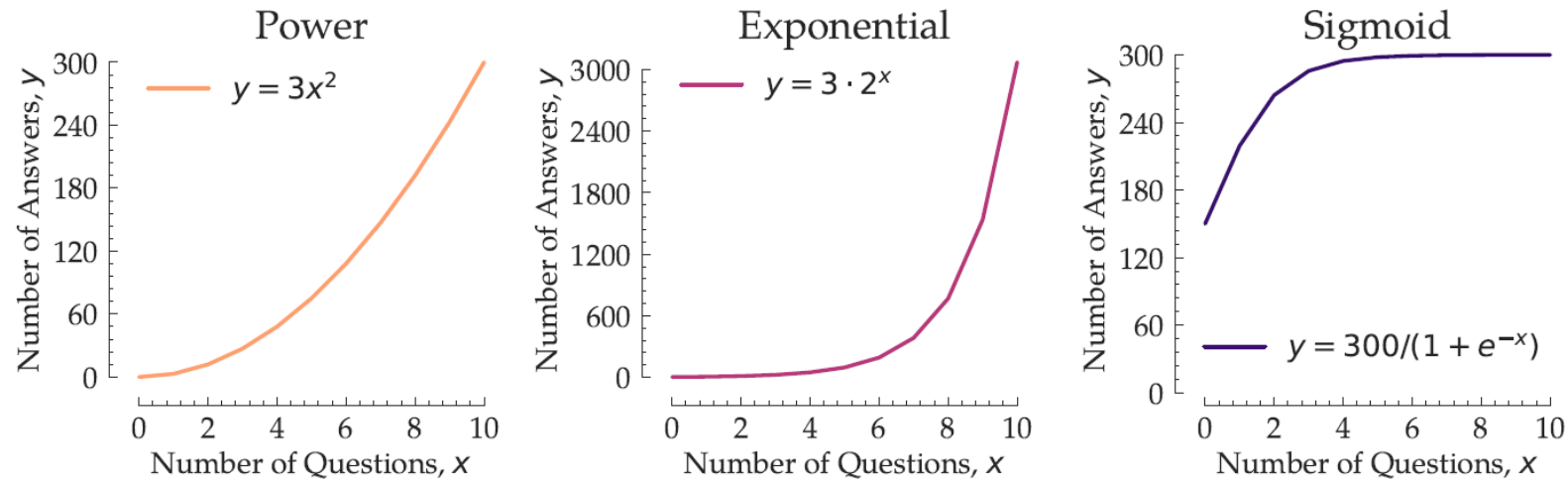
We model content generation using Macroeconomic production functions which concentrate on key **factors**.

We combine a **basis function** and an **interaction type** to capture these factors.



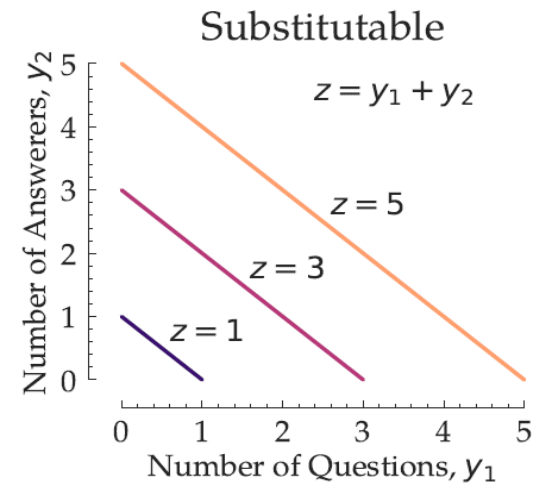
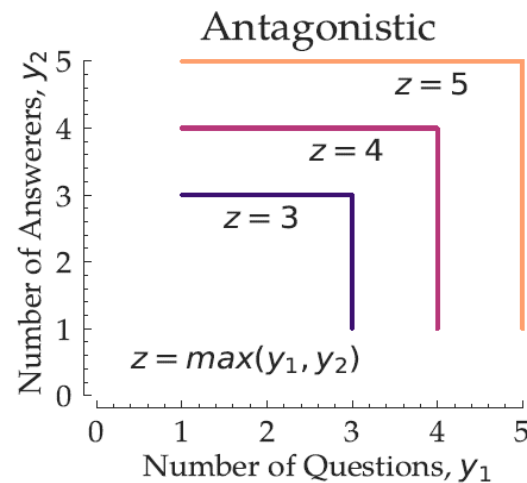
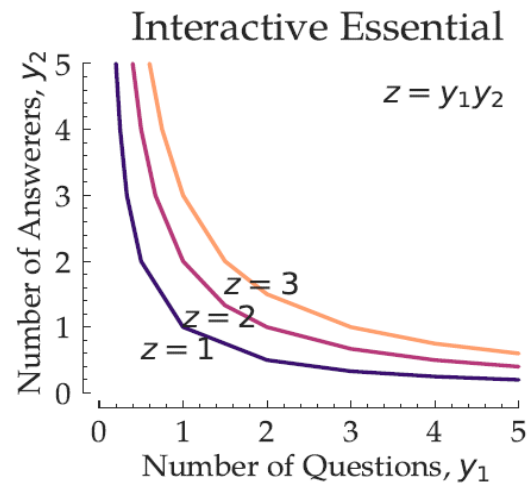
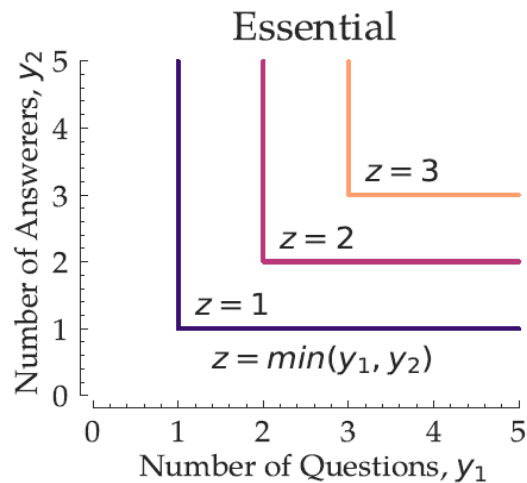
Basis Function

Basis function captures the relationship between an **input** and **output**

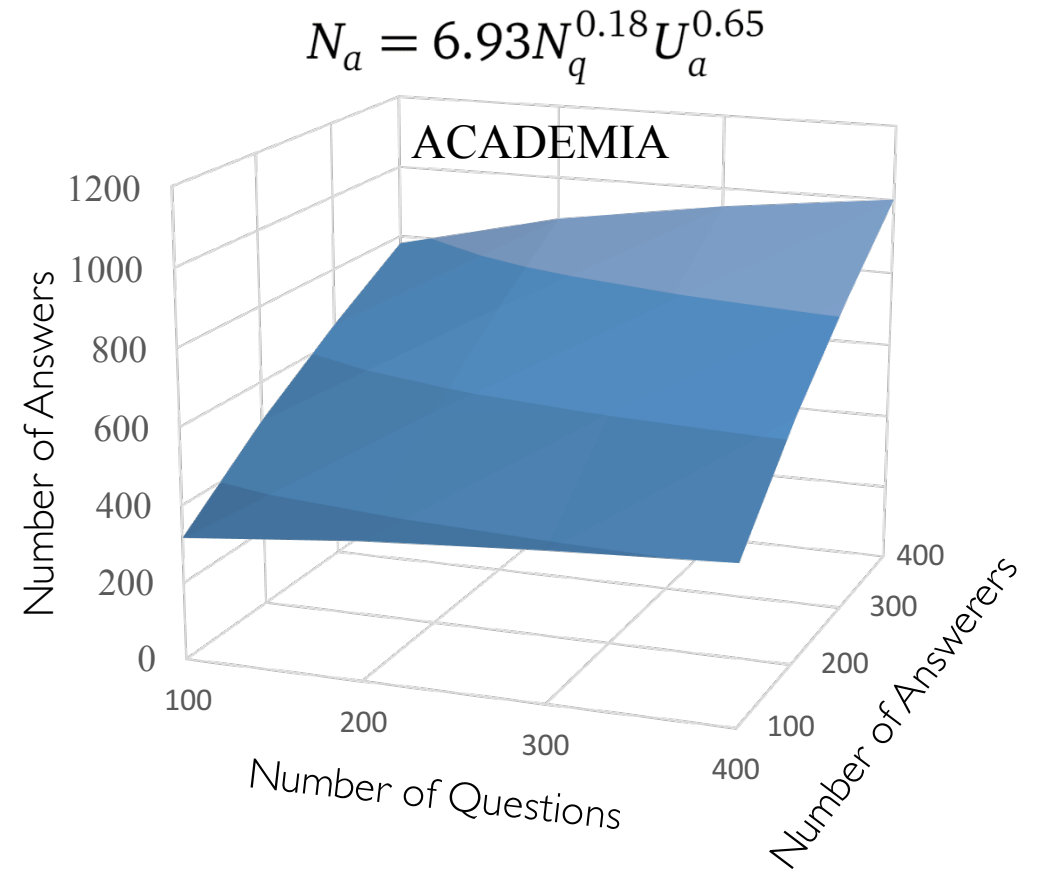
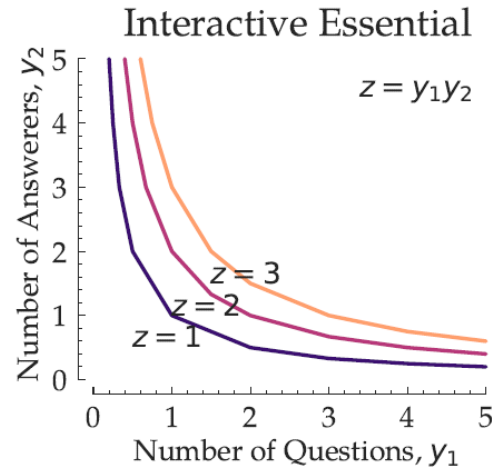
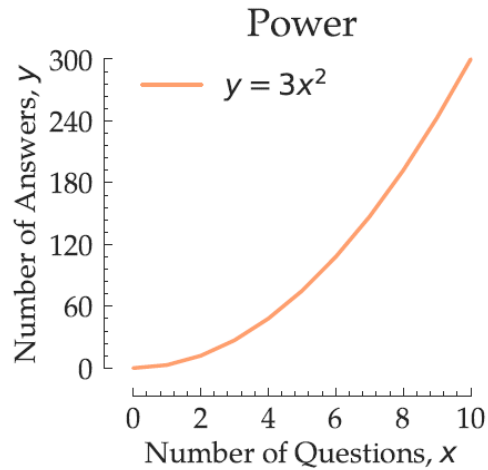


Interaction Type

Interaction type captures how different inputs interact to generate output

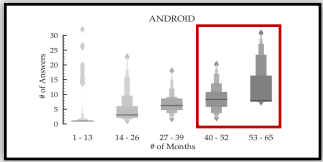
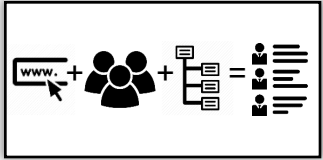


Cobb-Douglas Model



For an output z with two inputs x_1 and x_2 , the Cobb-Douglas function is

$$z = a x_1^{\lambda_1} x_2^{\lambda_2}$$



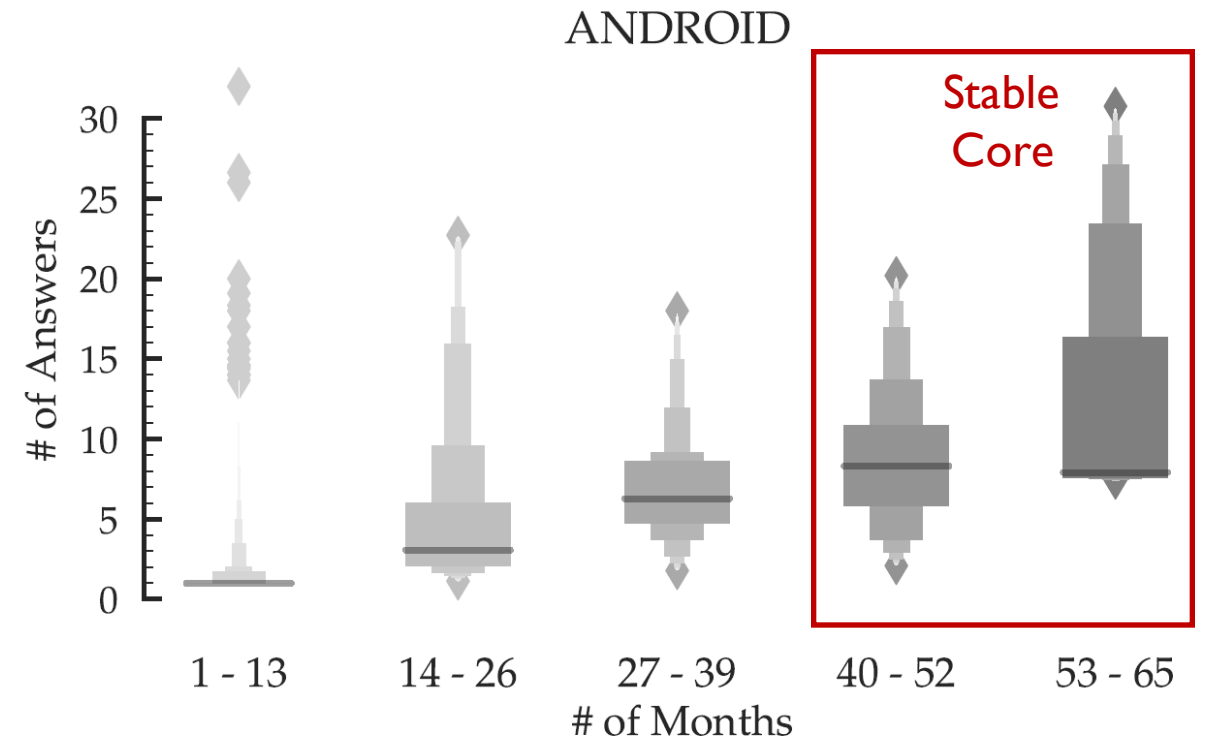
Motivation and
Problem Statement

Modeling Knowledge
Markets

**Knowledge Market
Characteristics**

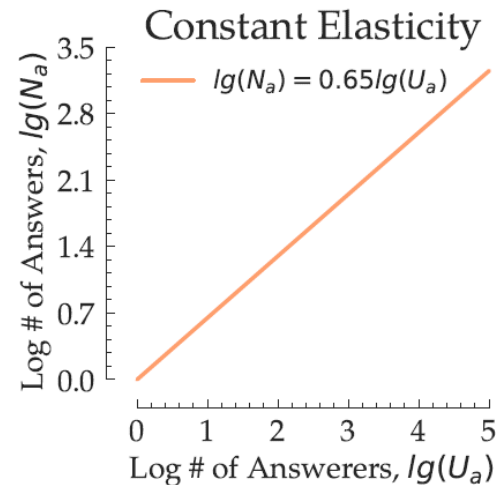
Knowledge Market
Failures

Conclusion and
Future Work

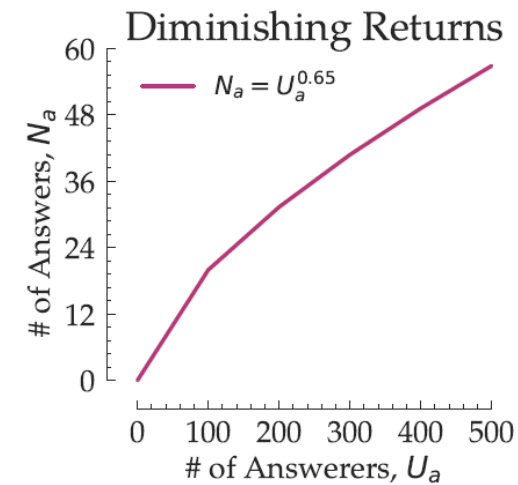


Model Interpretation

A percentage increase in **any** of the inputs leads to a constant percentage increase in the output

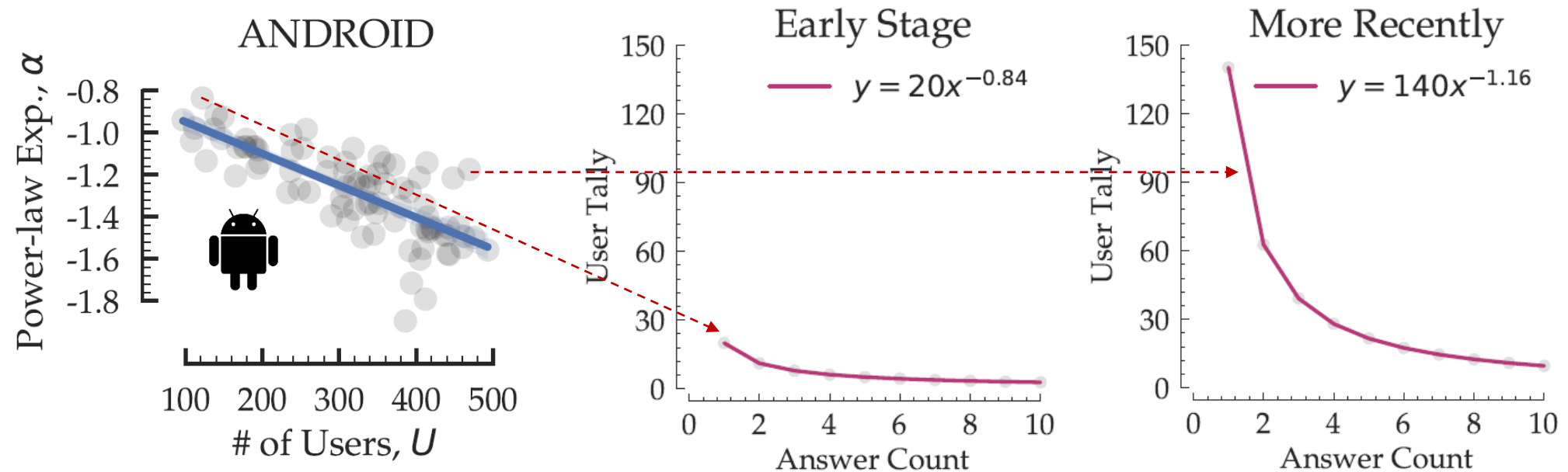


The **marginal** output decreases as an input is incrementally increased



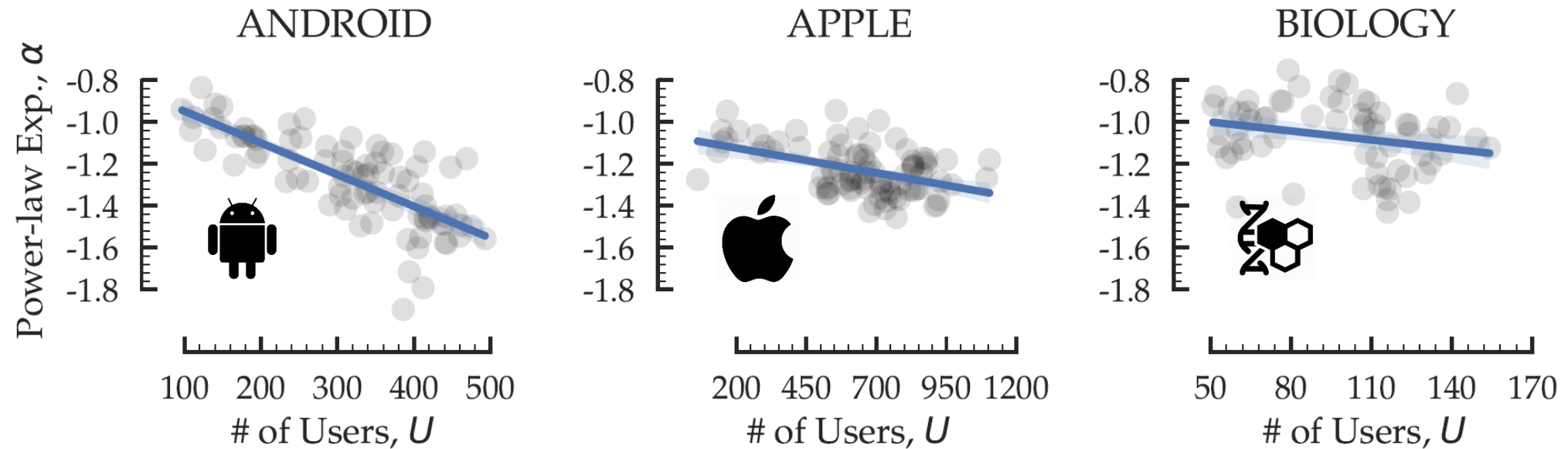
Size Dependent Distribution

The distribution of participant activities **evolves** with the number of participants.



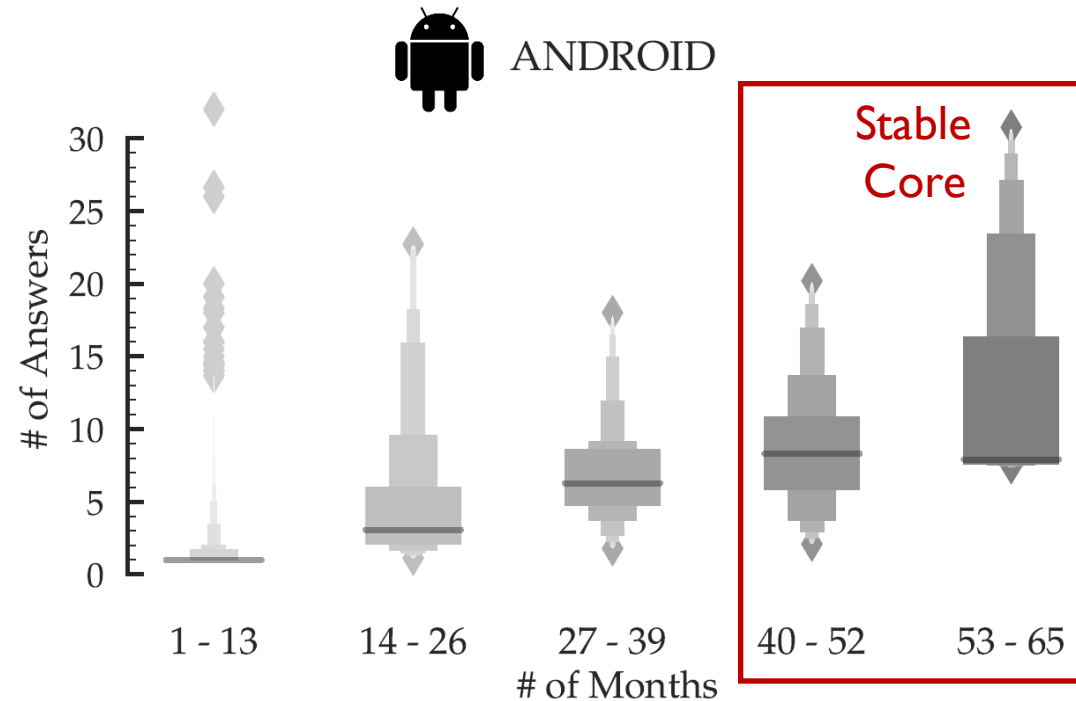
Size Dependent Distribution

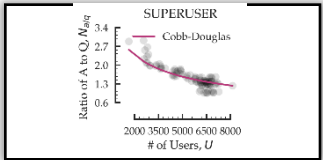
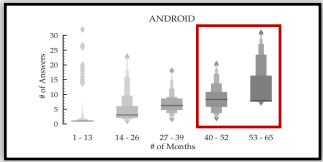
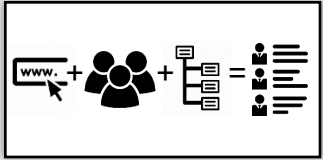
The distribution of participant activities **evolves** with the number of participants.



Stable Core

Stable core: users who contribute **many** answers for a **long** period





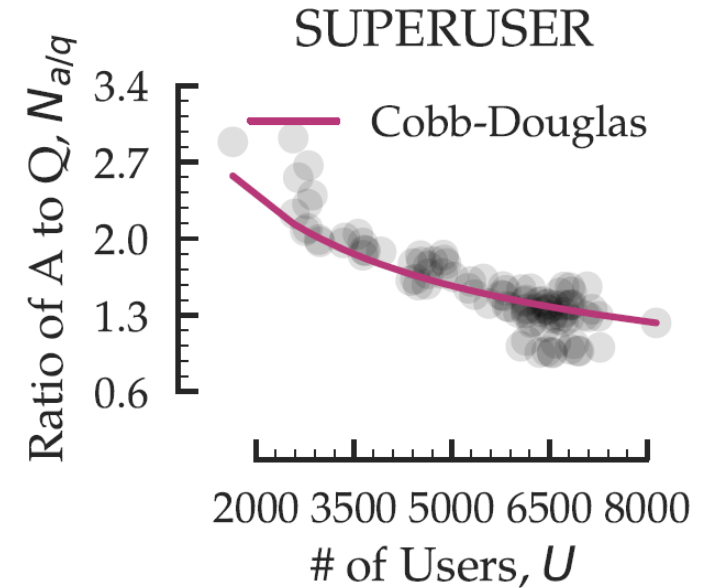
Motivation and
Problem Statement

Modeling Knowledge
Markets

Knowledge Market
Characteristics

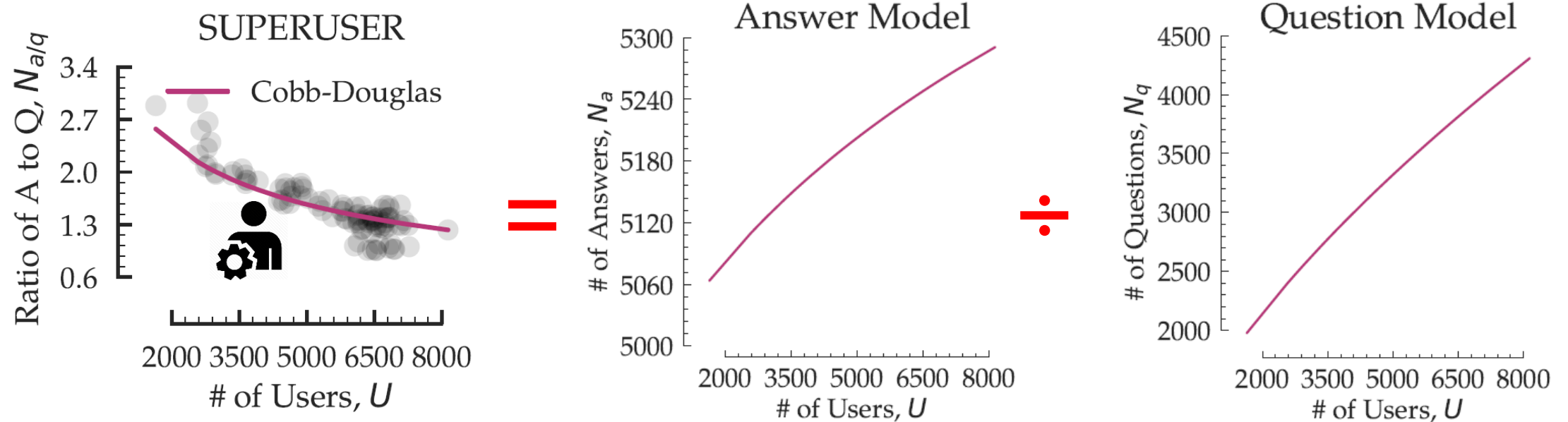
**Knowledge Market
Failures**

Implications and
Summary



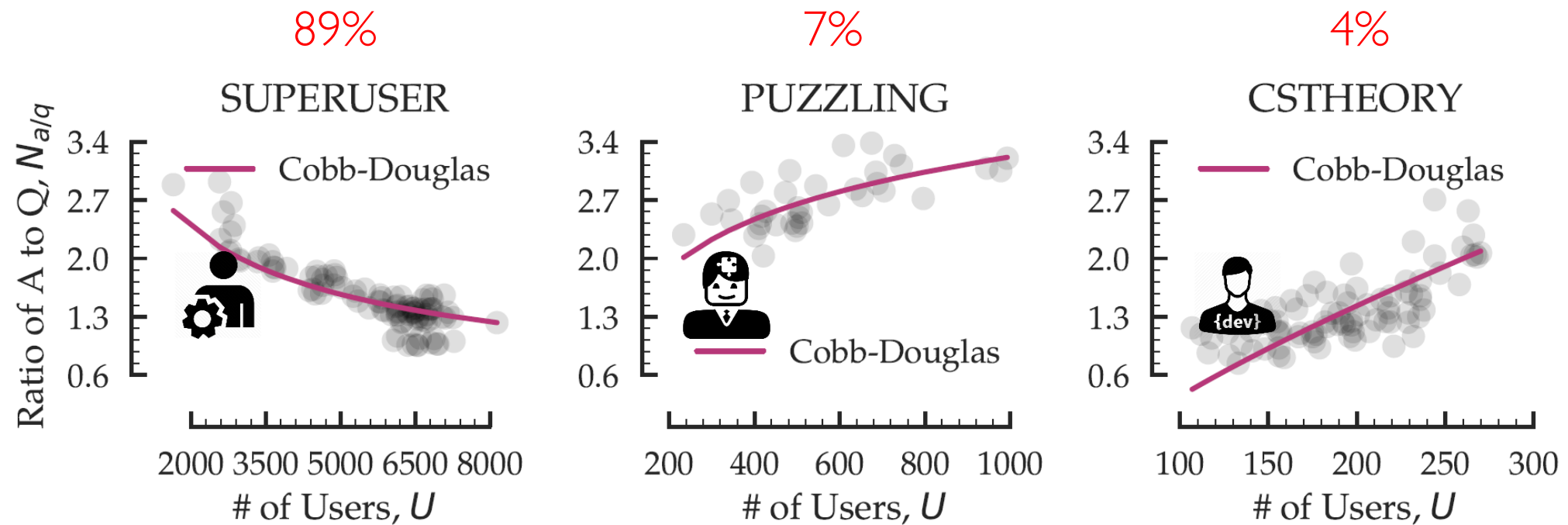
Dis(economies) of Scale

The ratio of answers to questions ($N_{a/q}$) **decreasing** (increasing) with the **increase** in number of users (U).



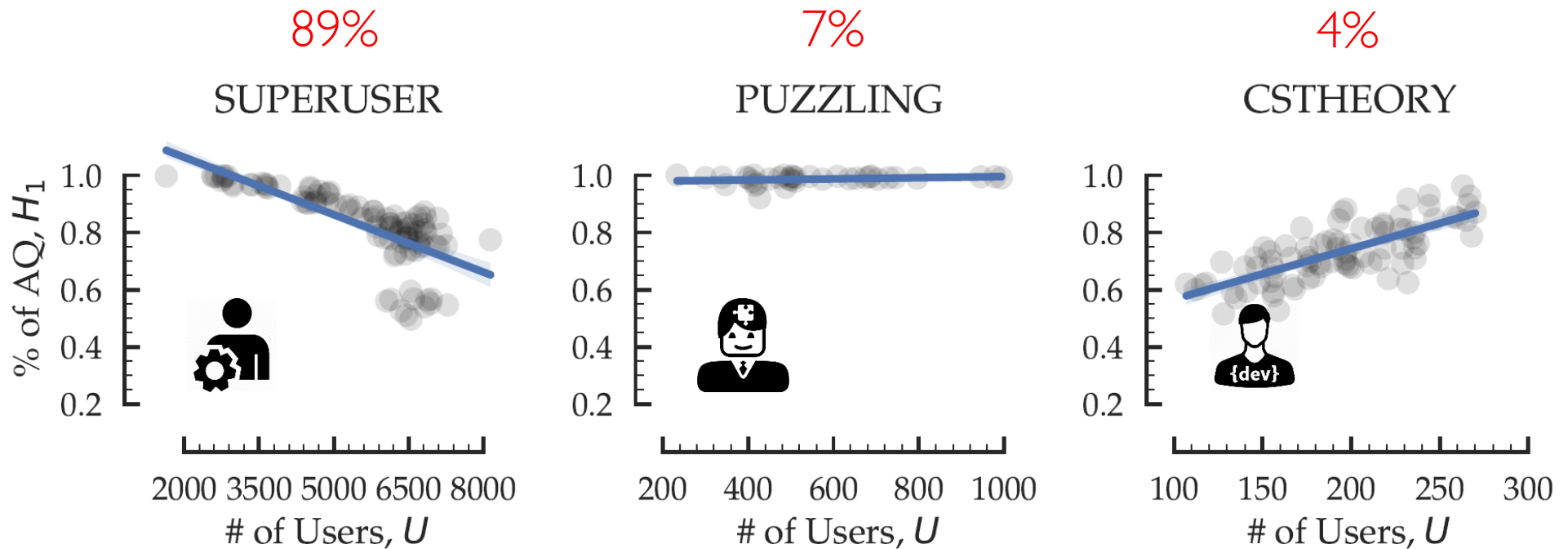
Dis(economies) of Scale

The ratio of answers to questions ($N_{a/q}$) **decreasing** (increasing) with the **increase** in number of users (U).



Health at Scale - I

In most StackExchanges, the fraction of questions with at least one answer (H_1) **decreases** with the **increase** in number of users (U).

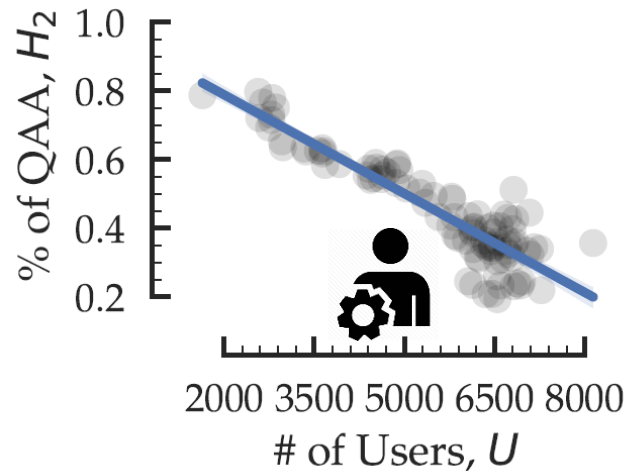


Health at Scale - II

In most StackExchanges, the fraction of questions with an accepted answer (H_2) **decreases** with the **increase** in number of users (U).

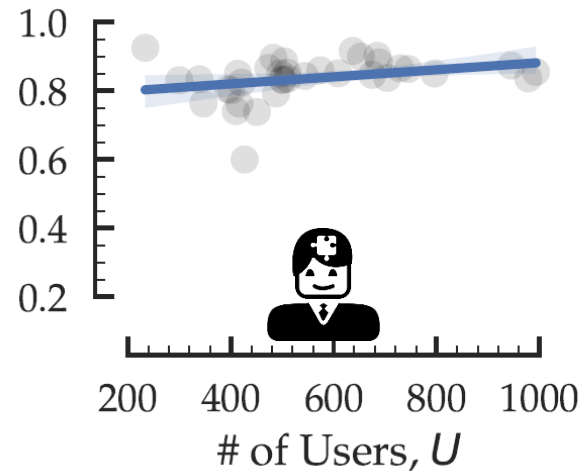
89%

SUPERUSER



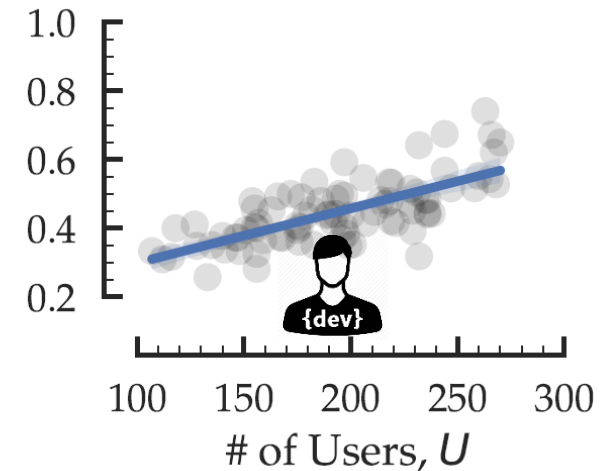
7%

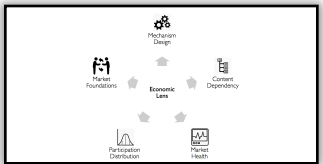
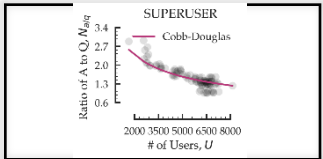
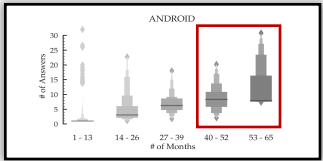
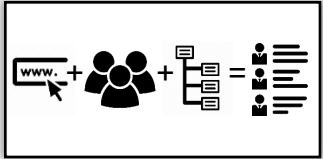
PUZZLING



4%

CSTHEORY





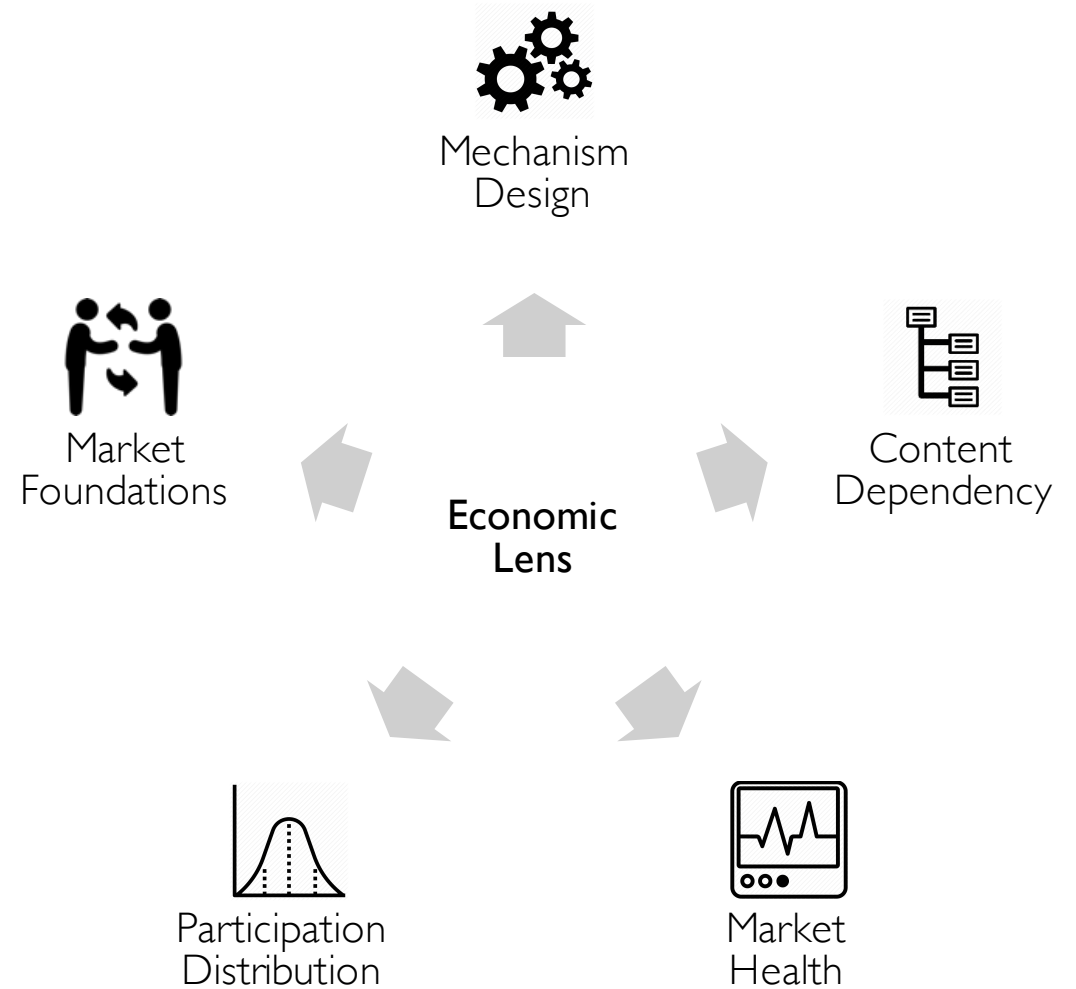
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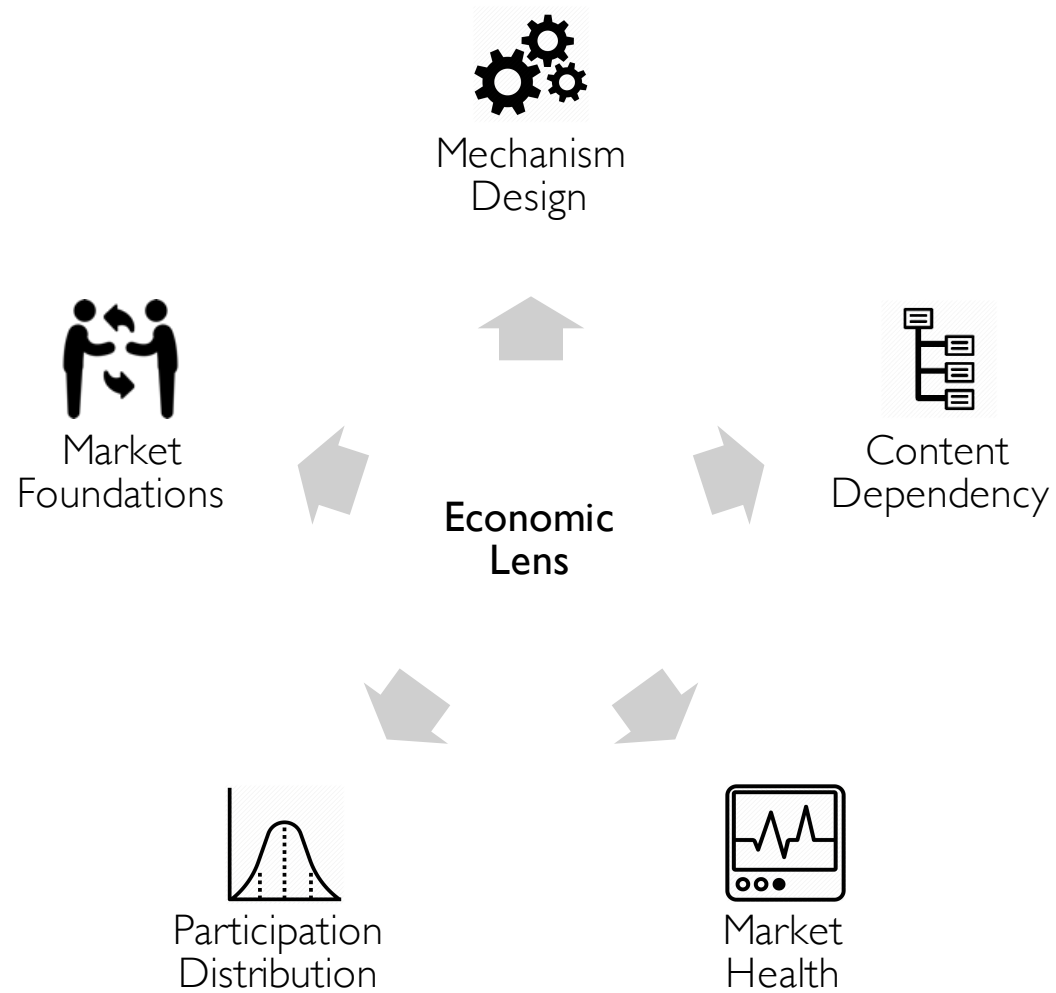
Knowledge Market
Characteristics

Knowledge Market
Failures

Implications and
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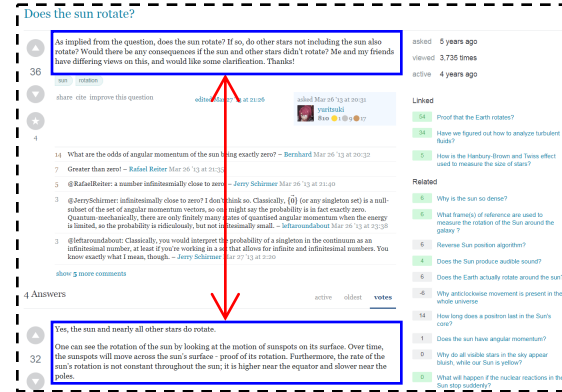


Implications

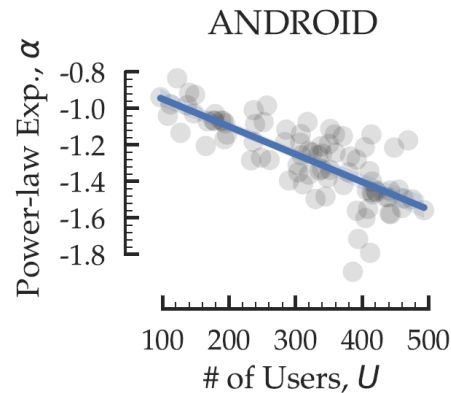


Summary

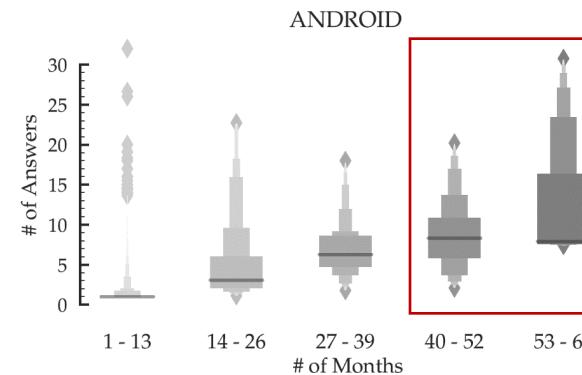
Key Idea:



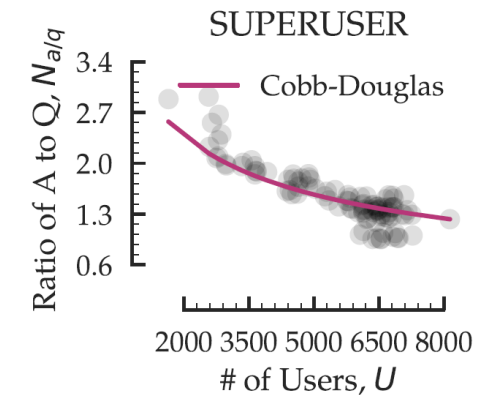
Findings:



Size Dependent Distribution



Stable Core



Diseconomies of Scale

GitHub : <https://github.com/information-market/knowledge-market-sustainability>