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1. Introduction

The chosen innovation for this analysis is **ThredUp's AI Search**, an artificial-intelligence–powered resale feature designed to improve user experience in second-hand fashion marketplaces. ThredUp allows users to buy and sell pre-owned clothing online and is one of the largest digital thrift platforms in the <u>United States</u>.

To model its potential adoption, I selected eBay's active buyers as a *look-alike innovation, an analog*. eBay, like ThredUp, is an online marketplace that relies on digital trust, convenience, and user-to-user transactions (C2C). Although PoshMark may have been a closer alternative to ThredUp, eBay's long historical data provides an ideal foundation for estimating how innovations in similar online consumer spaces diffuse over time.

Since ThredUp's AI Search is a new feature within an existing platform, eBay's cumulative account growth and pioneering in the industry serves as a reasonable proxy for how users might gradually adopt AI-driven resale tools.

2. Data and Methodology

Quarterly data on eBay's active buyers (2010–2025) was collected from *Statista*. However, the Bass Diffusion Model requires cumulative adoption data (e.g. total users over time, in this case) rather than a fluctuating measure like *active buyers*.

Active buyers can increase or decrease depending on user engagement or inactivity, but cumulative accounts reflect the total number of users who have ever joined the platform. Because the Bass model assumes adoption is monotonically increasing (no one technically "unadopts"), I first transformed the active buyer series into cumulative accounts using an estimated churn rate to adjust for user attrition.

Estimating the Churn Rate

As eBay's public data does not include total registered accounts, a Fermi approximation was used to estimate quarterly churn:

Real-world subscription churn tends to fall between 5–7% annually, but marketplace / retail user churn may logically be higher due to weaker switching costs and lower commitment. So I estimated an annual churn rate of about 20%

Converting this to a quarterly rate as my data is quarterly:

$$r_q = 1 - (1 - 0.2)^{1/4} \approx 0.053$$

Thus the churn rate estimate is: 5.3% per quarter.

Cumulative accounts were then estimated:

$$C_t = C_{t-1} + \frac{A_t}{1-r_q},$$

Where A_t is the active buyer count at time t and r_q is the already estimated churn rate.

3. Bass Model Parameters

The **Bass Diffusion Model** was fit to the reconstructed cumulative account data. It models the rate of new adopters as a function of both external and internal influence:

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$$\frac{f(t)}{1 - F(t)} = p + \frac{q}{M}[A(t)]$$

where:

- **p** = coefficient of innovation
- **q** = coefficient of imitation
- **M** = total potential market (millions)

Parameters were estimated by minimizing the **SSE** between predicted and observed cumulative accounts.

Parameter	Meaning	Estimated Value
p	Coefficient of innovation	≈ 0.0398
q	Coefficient of imitation	≈ 0.0001
M	Market potential (millions)	≈ 189

The low imitation effect (q) relative to innovation (p) explains why eBay's diffusion curve appeared nearly linear, as people joined mainly because of outside influences such as marketing, advertising, brand awareness, or platform reputation, and not because other users recommended it.

The Bass model fit the overall growth pattern well but could not model later declines.

Bass Model Fit for eBay (Cumulative Accounts)
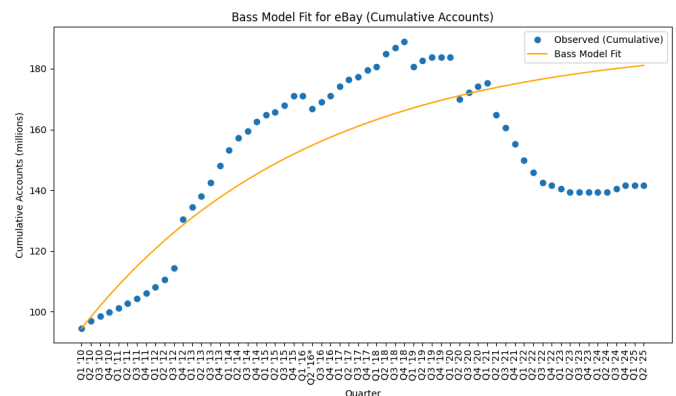
4. U.S. Market Focus and Determining *M*

ThredUp currently ships only within the United States and Canada, as confirmed by its official help page (help.thredup.com).
Therefore, the forecast was limited to the U.S. market.

According to *Yaguara.co*, there were approximately **274.70 million online shoppers in the United States** in 2023. And thus my data dates all the way to 2025, it is highly likely that more people would shop online. Thus I estimated the total amount to be **285 million.** Using a **Fermi approximation** for potential second-hand shoppers:

1. ~285 million total online shoppers
2. Assuming 30% buy <u>clothing</u> online → 85 million
3. Assume 25% interested in resale or sustainable fashion (second hand shopping) → 21 million
4. Round upward for new entrants and second hand luxury shoppers → **≈ 50 million potential users**

Thus, **M = 50 million** was adopted as a realistic (?) market potential for ThredUp's AI Search.

## 5. Forecasting Diffusion of ThredUp AI Search

Using the parameters estimated from eBay, the diffusion of ThredUp's AI Search feature was forecasted for **20 quarters (5 years)**.

The results showed a **gradual but consistent rise** in cumulative adopters, reaching around 50 million users near the end of the forecast period. The new adopters per quarter curve was nearly flat, reflecting steady rather than viral growth — consistent with features that rely primarily on marketing and platform integration rather than peer imitation, which may be quite intuitive as most people get to know of retail platforms through marketing and social media ads.

ThredUp AI Search Forecast (Global Scope, Bass Model)
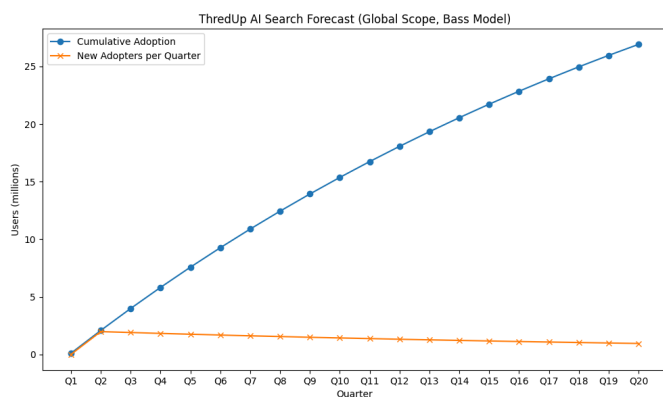
To test an alternative scenario, parameters were adjusted to p=0.03 and q=0.45, typical of high-imitation consumer technologies, assuming that people share their good experience with ThredUp. This produced a strong S-shaped cumulative curve and bell-shaped new-adopter curve, demonstrating that greater imitation effects

can substantially accelerate adoption and shorten the time to saturation.
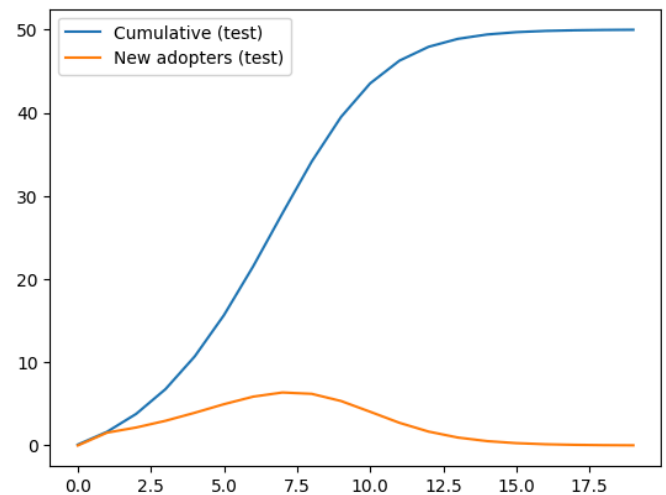
6. Interpretation

The Bass model indicates that ThredUp's AI Search feature is likely to experience steady adoption among U.S. users, reaching saturation within five years if sustained marketing and integration continue.

Early quarters: Adoption mainly driven by platform exposure and updates.

Middle phase: Gradual increase as users experiment and share experiences.

Later quarters: Slowdown as most potential users have already adopted.

The sensitivity analysis (higher q) highlights the importance of social influence: if ThredUp promotes AI Search through influencers or resale communities, adoption could accelerate more sharply toward the classic Bass S-curve pattern.

7. Conclusion

By transforming eBay's active user data into cumulative accounts and accounting for churn, a realistic diffusion pattern was estimated.
Using these parameters, the Bass Diffusion Model provides a clear picture of how ThredUp's AI Search feature could diffuse across the U.S. resale market. The findings suggest gradual, marketing-driven adoption, with the potential for faster growth if imitation effects increase through community engagement or viral visibility.

8. Sources

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