

What the items in your shopping cart reveal about the likelihood of returns

ASU business professor suggests new approach to analyzing customer return behavior

By Marshall Terrill , ASU News
January 15, 2026

Online returns have quietly become one of the most expensive and complex challenges facing modern retail.

As e-commerce continues to grow, so does the volume of products flowing backward through the supply chain, costing retailers billions each year while straining logistics networks and sustainability goals. Yet despite the scale of the problem, most forecasting tools still examine returns one product at a time, often overlooking how customers actually shop in the real world.

[Guangzhi Shang](#), associate professor in the [NASPO Department of Supply Chain Management](#) at Arizona State University's [W. P. Carey School of Business](#), saw a disconnect between academic models and industry reality. Through conversations with retail leaders and practitioners in reverse logistics, a recurring question emerged: Could retailers predict returns more accurately by examining not individual items, but the entire shopping basket? That question became the foundation of a research paper he co-authored with three other researchers¹, "[Order Basket Contents and Consumer Returns](#)."

Rather than treating products as isolated decisions, Shang's work focuses on the relationships between items purchased together. By examining whether products complement or substitute for one another within a single order, his research reveals new insights into customer intent. It also signals that traditional item-level analysis often misses. This basket-level perspective helps explain why some orders are far more likely to be returned than others.

These insights arrive at a critical moment for retailers, particularly during peak return periods, such as January. Beyond improving forecasts, Shang's research suggests practical strategies for making more thoughtful recommendations, designing proactive baskets and utilizing AI-driven tools that can reduce returns without adding friction for customers.

In the following Q&A with ASU News, Shang discusses what inspired this research, how basket-level complementarity changes the way we think about returns, and why more innovative shopping carts could benefit not just retailers' bottom lines but also supply chain efficiency and sustainability efforts across the industry.

Question: What motivated you to look beyond individual products and focus on the *mix* of items in a shopping cart when studying returns?

Answer: Honestly, the motivation came straight from real-world headaches. Returns are a massive issue for online retailers — billions of dollars are lost, and tons of operational hassles ensue. While most research and forecasting tools focus on predicting returns for individual products, we have observed that in practice, people often purchase multiple items together. Retailers typically add up the return probabilities for each item, but that overlooks a more significant aspect: The combination of items in a basket can actually reveal a great deal about whether the order will be returned.

Our interest was sparked by conversations with industry leaders, especially at reverse logistics conferences. They kept asking: "Can we do better at forecasting returns if we look at the whole basket, not just the items?" That's when we realized there was a gap in both research and practice, and we wanted to fill it.

Q: How do you define and measure "complementarity" between products, and why is this approach different from how retailers typically analyze returns?

A: We define "complementarity" as how well two products go together to satisfy a consumer's needs — like a baseball and a glove, versus a baseball and a soccer ball. If two items are often bought together and kept, they're probably complementary.

To measure this, we use a data-driven metric called "degree of copurchase" (DCP). It's based on association rules from machine learning: We look at historical sales data to see how often two products are bought together (and not returned) compared to what you'd expect if purchases were random. If the DCP is positive, the items are complementary; if it's negative, they're substitutes or just unrelated.

This is different from the usual approach, where retailers might use product attributes (like color or style) or look at each item in isolation. Our method is practical because it doesn't require subjective judgments or complicated attribute matching — it's all in the data, and it scales easily.

Q: What did the data reveal about customer behavior when shoppers buy complementary items versus unrelated ones, and why do you think those differences occur?

A: The data were clear: When shoppers buy complementary items (high DCP), the chance of returning the order drops. But when they buy unrelated or substitute items (low or negative DCP), returns go up — sometimes sharply.

Why? We think it's about intent and utility. If you buy two items that go well together, you're probably planning to use them together, so you're less likely to return. But if you buy unrelated items, you might be "trying things out" — like ordering a few different styles to see what fits or looks best, then sending some back. This "home try-on" behavior is a big driver of returns, especially in online shopping, where you can't see or touch products before buying.

Interestingly, the effect is strongest when complementarity is low — returns spike when people are just experimenting. As complementarity increases, the impact on returns tapers off.

Q: With January being peak return season, how can retailers practically use these findings right now to reduce returns without adding friction for customers?

A: Retailers can use these insights in a couple of practical ways, especially during the post-holiday return rush.

Better forecasting: By factoring in basket-level complementarity, retailers can more accurately predict which orders are likely to be returned, helping with staffing, logistics and cost planning.

More thoughtful recommendations: Instead of just suggesting items that increase basket size, retailers can recommend complementary products that are likely to be kept together. This doesn't add friction for customers — it actually makes their shopping experience smoother and more relevant.

Proactive basket design: For example, if a customer has a watchband in their cart, suggest a bracelet that's often kept with it, rather than a random accessory. This can nudge customers toward baskets with lower return risk.

The key is that these strategies don't make returns harder for customers — they make it less likely that customers will want to return their purchases in the first place.

Q: How could this research be integrated into AI-driven recommendation systems or predictive tools used by online retailers?

A: It's a natural fit! Most recommendation engines focus on what customers are likely to buy, but they rarely consider what's likely to be returned. By integrating the DCP metric into AI systems, retailers can optimize for both sales and retention.

For example: Recommendation algorithms can be tweaked to suggest items that not only boost basket size but also have high complementarity with what's already in the cart, reducing the risk of returns.

Predictive models for returns can use basket-level features, in addition to item-level ones, to flag high-risk orders before they ship.

This means retailers can personalize recommendations and manage returns more effectively, all while leveraging the data they already have.

Q: Beyond profits, what implications does reducing returns through smarter basket design have for sustainability and supply chain efficiency?

A: Reducing returns isn't just about saving money — it's a win for sustainability and operational efficiency.

Less waste: Fewer returns means fewer products ending up in landfills or being liquidated at a loss.

Lower carbon footprint: Returns involve extra shipping, handling and repackaging, all of which add to increased emissions. Cutting down on returns helps the environment.

Streamlined logistics: If retailers can better predict and reduce returns, they can optimize staffing, warehouse space and third-party logistics contracts, making the whole supply chain more efficient.

So, smarter basket design isn't just good business — it's also good for the planet and for making retail operations run smoother.

This story originally appeared on [ASU News](#).

¹ The other co-authors are Mengmeng Wang, Tongji University; Ying Rong, Shanghai Jiao Tong University; and Micheal R. Galbreth, University of Tennessee.

Main image



Photo illustration courtesy of iStock/Getty Images

Text image(s)



Guangzhi Shang