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School of Computer Science & Engineering

IILM University Greater Noida

Presents

1st National Conference

on

Technologies for Sustainable Development Goals 2025 (TECH4SDG-2025)

3rd March 2025

Technically Co-Sponsored by IEEE UP SECTION (INDIA)

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INTERNATIONAL JOURNAL OF RESEARCH IN MODERN ENGINEERING & EMERGING TECHNOLOGY (IJRMEET)

Dear Author / Researcher,

On behalf of the *International Journal of Research in Modern Engineering & Emerging Technology (IJRMEET)*, I extend my heartfelt gratitude to all the authors and research scholars for choosing our platform to publish their valuable research contributions.

IJRMEET, a Refereed, Peer Reviewed, Indexed, and Monthly Journal in Electronic format, has been consistently dedicated since April 2013 to advancing scholarly work in the domains of Modern Engineering and Emerging Technologies. Your innovative and quality research is at the core of our mission to promote academic excellence and practical solutions in the ever-evolving field of engineering and technology.

We believe that publication should be based purely on the merit, originality, and relevance of the research, not on financial considerations. We ensure that every manuscript undergoes a thorough review process to maintain the integrity, reliability, and scholarly value of each published work.

Our journal aims not only to disseminate high-quality research globally but also to highlight critical engineering problems and their practical resolutions. I encourage researchers, academicians, faculty members, and industry professionals to continue contributing to IJRMEET and to inspire their peers and students to join us in this academic pursuit.

We sincerely thank our respected Editors, Reviewers, Technical Advisors, Authors, Web Developers, Subscribers, Supporters, and the extended academic community whose efforts and encouragement make each issue of IJRMEET a successful endeavor.

With warm regards,

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डॉ. मोहम्मद रिहान / Dr. Mohammad Rihan
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MESSAGE

I am happy to know about Tech4SDG-2025, a distinguished national conference that aims to explore and highlight the transformative power of technology in achieving the United Nations Sustainable Development Goals (SDGs). This event serves as a critical platform for fostering collaboration among experts, innovators, and leaders who are dedicated to creating solutions that drive sustainable change.

As we face global challenges ranging from environmental sustainability to social equity, it is clear that technological advancements will play a pivotal role in shaping our collective future. Tech4SDG-2025 presents a unique opportunity to examine how cutting-edge technologies can contribute to solving the most pressing issues of our time, from climate change to poverty alleviation.

I look forward to the engaging discussions and innovative ideas that will emerge from this conference. I believe that by working together, we can harness the potential of technology to drive meaningful progress towards a sustainable and equitable world.

I extend my best wishes to all the participants and organizers of Tech4SDG-2025.

27.02.25

(Dr. Mohammad Rihan)

Dated: 27th February, 2025
Place: Gurugram

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Merchandising Optimization Techniques for Users in Online Marketplaces

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Abstract : Online marketplaces host thousands of competing sellers, and what a shopper sees first has a large influence on what is bought. This study tested merchandising techniques in a six-week randomised field experiment on a multi-seller marketplace. A total of 90,000 shopper sessions were assigned at random to one of five arms: a control with popularity-based sorting, personalised ranking, enhanced product listings (larger images, rating summaries and delivery badges), cross-sell bundles, and a combination of the three techniques. Conversion was 3.10% in the control and 3.58%, 3.41%, 3.22% and 4.05% in the other arms (overall $\chi^2 = 29.5$, $p < 0.001$). Personalised ranking raised conversion by 15% relative to control, and the combined arm by 31%. Cross-sell bundles did not change conversion significantly but raised average order value from ₹1,420 to ₹1,590. Revenue per session rose from ₹44.0 in the control to ₹65.2 in the combined arm. The effects were similar for new and returning visitors. Techniques that improve relevance and techniques that raise basket size work through different routes, and their combination gives the largest commercial gain.

Keywords: merchandising; online marketplace; personalised ranking; product listings; cross-selling; conversion rate; A/B testing

Introduction

In a physical store, merchandising means choosing which products to stock, where to place them and how to display them. In an online marketplace the same decisions are made by software. The marketplace decides which items appear at the top of a search or category page, how each item is presented and which other items are suggested next to it. Because shoppers rarely look beyond the first screen of results, these decisions have a direct effect on sellers' sales and on the revenue of the marketplace.

Marketplaces also face a particular difficulty. They list very large assortments from many sellers of uneven quality, and the shopper cannot inspect the product. A wide choice can help shoppers find what they want, but it can also be overwhelming (Iyengar & Lepper, 2000). Merchandising therefore has to reduce effort for the shopper while supporting the commercial goals of the platform.

Many techniques are in use, including ranking by popularity or relevance, personalisation, richer listing content, social proof such as ratings, and recommendations for related items. Their effects are often reported from the point of view of algorithm accuracy, while evidence from controlled commercial tests is less common (Jannach & Jugovac, 2019). It is also unclear whether techniques that increase conversion and those that increase basket value add up when used together.

This study compares three merchandising techniques and their combination against a standard popularity sort in a randomised experiment. It asks how each technique changes click-through, conversion, average order value and revenue per session, whether effects differ between new and returning visitors, and how the techniques should be combined in practice.

Literature Review

The study of online shopping behaviour has relied on clickstream data to understand how shoppers move through a site. Bucklin and Sismeiro (2009) reviewed advances in the analysis of such data and showed that the path a shopper takes can be linked to purchase outcomes. A central finding of research on ranked lists is position bias: items placed higher are clicked more often partly because of position and not only because of quality. Joachims et al. (2005) showed with eye-tracking and click data that users scan results from the top and trust their order, so interpreting clicks needs care and ranking has a strong effect on exposure.

Personalisation is the most studied technique. Recommender systems use the history of a user and of similar users to predict preferences (Adomavicius & Tuzhilin, 2005; Ricci et al., 2015). Linden et al. (2003) described item-to-item collaborative filtering at a large online retailer, which scaled to millions of products and became the basis for many later systems. In a review of commercial evaluations, Jannach and Jugovac (2019) found that recommender systems often lead to gains in click-through, sales and revenue, although the size

varies widely between settings and many reports concern only a single metric.

The way products are presented also matters. Huang et al. (2009) found that shoppers search differently for goods whose quality can be judged from descriptions and for goods that must be experienced, and that the second type benefits from richer information. Chevalier and Mayzlin (2006) showed that customer reviews affect sales of books, and that the effect of a negative review is stronger than that of a positive one. These results support the use of ratings, images and trust signals in listings, especially in marketplaces where sellers are unknown to the buyer.

Assortment size and variety have a double effect. Brynjolfsson et al. (2003) estimated that the greater variety available online produced substantial gains for consumers, while Iyengar and Lepper (2000) showed that an excess of options can reduce the likelihood of choosing. Merchandising techniques that organise a large assortment are therefore valuable, since they allow shoppers to enjoy the variety without being overloaded.

Evidence of causal effects needs controlled experiments. Kohavi et al. (2020) set out the principles of trustworthy online controlled experiments, including random assignment of users, pre-specified metrics, adequate sample size and care with multiple comparisons. Three gaps follow from this literature. Few studies compare several merchandising techniques in the same experiment on a marketplace, results for revenue and basket value are less often reported with conversion, and the effect of combining techniques is rarely tested. This study addresses these gaps.

Research Methodology

Setting and design

The experiment was conducted on a multi-seller marketplace selling consumer goods in categories such as home products, personal accessories and electronics accessories. Over six weeks, eligible sessions of logged-in and guest visitors on category and search pages were assigned at random, with a fixed seed, to one of five arms, with 18,000 sessions per arm. Assignment was made by a hash of the visitor identifier so that a visitor saw the same arm throughout. Sessions from sellers, staff and automated traffic were excluded. Figure 1 shows the framework of the experiment.

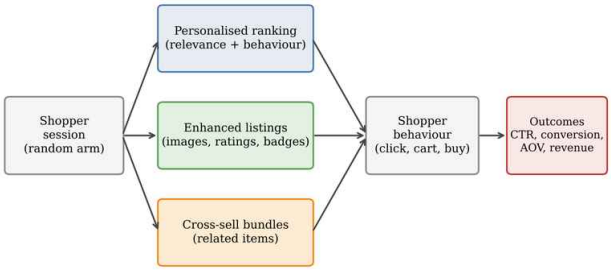

Figure 1. Experimental framework: three merchandising techniques and their outcomes.

Arms

Table 1. Experimental arms

Arm	Description
Control (popularity sort)	Items in category and search pages sorted by recent sales volume (existing practice)
Personalised ranking	Items re-ranked using a relevance score plus the visitor's recent views and purchases
Enhanced listings	Larger primary image, rating summary with review count, delivery-time and return-policy badges
Cross-sell bundles	Block of related and frequently bought-together items on the product and cart pages
Combined	Personalised ranking, enhanced listings and cross-sell bundles together

Outcome measures

The primary outcome was conversion, the share of sessions that ended in at least one order. Secondary outcomes were click-through (share of sessions with a click on a product), average order value in Indian rupees among sessions with an order, and revenue per session, calculated as conversion multiplied by average order value. Orders that were cancelled before dispatch were excluded.

Statistical analysis

Each treatment arm was compared with the control. Proportions were compared with a two-proportion z test, and relative effects are given as rate ratios with 95% confidence intervals from the log method. Confidence intervals for single proportions use the Wilson method (Wilson, 1927). Average order value was compared with Welch's t test, and the overall difference in conversion across arms with the chi-square test (Agresti, 2013). Because four comparisons were made against the control, the Bonferroni-adjusted level of significance was 0.0125. Effects were also estimated separately for new and returning visitors, comparing the control with the combined arm.

Results

Click-through and conversion

Click-through was 11.8% in the control, and higher in the personalised arm (13.6%; p <0.001), the enhanced listing arm (12.7%; p = 0.009) and the combined arm (14.4%; p <0.001), while the cross-sell arm (11.9%) did not differ from the control. Conversion differed across the five arms (χ^2 = 29.5, p <0.001; Table 2, Figure 2). Personalised ranking increased conversion by 15% (rate ratio 1.15, 95% CI 1.03–1.29, p = 0.012), which is significant at the adjusted level, though only just. Enhanced listings increased it by 10%, but the confidence interval included no effect (rate ratio 1.10, 95% CI 0.98–1.23, p = 0.096). Cross-sell bundles had no clear effect on conversion (rate ratio 1.04, 95% CI 0.93–1.17, p = 0.508). The combined arm produced the largest gain, of 31% (rate ratio 1.31, 95% CI 1.17–1.46, p <0.001).

Table 2. Click-through and conversion by arm

Arm	Sessions with click, n (%)	Orders, n (%)	95% CI (%)	Rate ratio	p
Control (popularity sort)	2,124 (11.8)	558 (3.10)	2.86–3.36	—	—
Personalised ranking	2,448 (13.6)	644 (3.58)	3.32–3.86	1.15	= 0.012
Enhanced listings	2,286 (12.7)	614 (3.41)	3.16–3.69	1.10	= 0.096
Cross-sell bundles	2,142 (11.9)	580 (3.22)	2.97–3.49	1.04	= 0.508
Combined	2,592 (14.4)	729 (4.05)	3.77–4.35	1.31	<0.001

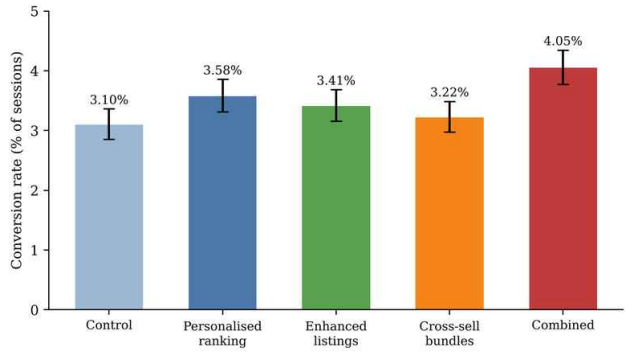

Figure 2. Conversion rate by arm (error bars are 95% Wilson confidence intervals).

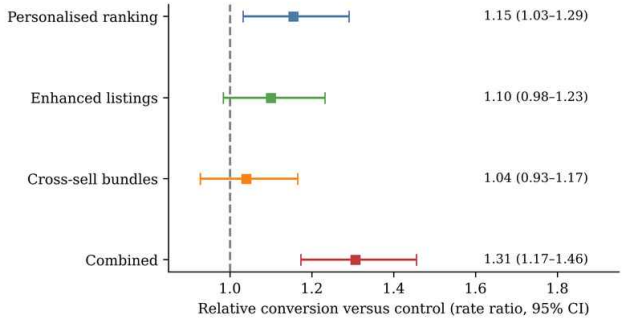

Figure 3. Relative conversion of each treatment arm against the control.

Order value and revenue

Average order value was ₹1,420 in the control. It was almost unchanged in the personalised arm (₹1,435; p = 0.750) and the enhanced listing arm (₹1,432; p = 0.803), but it was higher in the cross-sell arm (₹1,590; p <0.001, d = 0.20) and the combined arm (₹1,610; p <0.001, d = 0.23). Revenue per session was therefore higher in every treatment arm (a descriptive figure, not tested separately), from ₹44.0 in the control to ₹51.3 (personalised), ₹48.8 (listings), ₹51.2 (cross-sell) and ₹65.2 (combined), the last being 48% higher than the control (Figure 4). The mechanisms differ: personalisation raised the number of orders, cross-selling raised the value of each order, and the combined arm gained from both.

Table 3. Order value and revenue per session

Arm	Orders	Average order value, ₹ (SD)	Welch t	p	Revenue per session, ₹
Control (popularity sort)	558	1,420 (820)	—	—	44.0
Personalised ranking	644	1,435 (810)	0.32	= 0.750	51.3
Enhanced listings	614	1,432 (825)	0.25	= 0.803	48.8
Cross-sell bundles	580	1,590 (840)	3.45	<0.001	51.2
Combined	729	1,610 (835)	4.09	<0.001	65.2

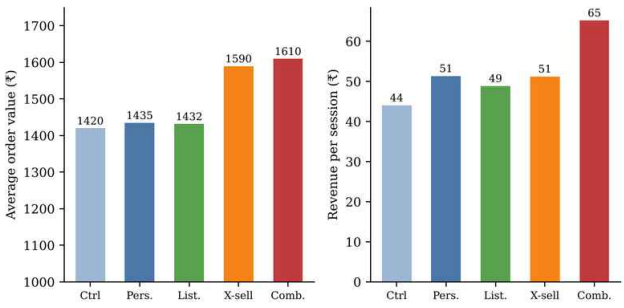

Figure 4. Average order value and revenue per session by arm.

New and returning visitors

The combined arm improved conversion in both visitor types. Among new visitors it rose from 2.60% to 3.42% (rate ratio 1.32, 95% CI 1.12–1.55), and among returning visitors from 3.65% to 4.72% (rate ratio 1.29, 95% CI 1.12–1.49). The two ratios are close, so the combined treatment does not appear to depend on how well the shopper already knows the marketplace, although returning visitors converted at a higher level in both arms.

Discussion

The results show that merchandising is a source of commercial gain on a marketplace, and that its techniques act in different ways. Personalised ranking improved click-through and conversion, which fits the evidence that matching items to a shopper's interests reduces the effort of search (Adomavicius & Tuzhilin, 2005; Jannach & Jugovac, 2019). Its effect on conversion, a relative gain of about 15%, was moderate and near the edge of significance after adjustment, so the size of the benefit should be treated with caution.

Enhanced listings raised click-through, but the increase in conversion was not conclusive. A plausible reading is that richer images and rating summaries made products more attractive to open but that other factors, such as price and delivery, decided the purchase. This agrees with the finding that information is most valuable for goods that must be judged by experience (Huang et al., 2009) and with the evidence on the importance of reviews (Chevalier & Mayzlin, 2006). A larger sample or a longer test might clarify the effect.

Cross-sell bundles did not change how many shoppers bought but increased how much they spent. This is the pattern expected from item-to-item recommendations that suggest complementary items at the point of purchase (Linden et al., 2003). It also shows the risk of judging merchandising by conversion alone: a technique with no effect on conversion produced a clear rise in revenue per session.

The combination of techniques gave the largest gain in conversion and in revenue per session. The gains came from different routes, more orders from relevance and larger orders from bundles, and so they accumulated. For marketplace operators the practical conclusion is to plan merchandising as a set of complementary techniques, to choose metrics that include order value and revenue, and to test changes through randomised experiments with adjustment for multiple comparisons, in line with the principles set out by Kohavi et al. (2020). Sellers can use the findings to prioritise complete listings with images, ratings and delivery information, which improve visibility under relevance-based ranking.

Limitations

The experiment was run on a single marketplace for six weeks, and the results may differ in other product categories, markets or seasons, including festival periods when behaviour changes. The combined arm did not test each pairing of techniques, so interactions cannot be separated. Revenue was measured at order and not net of returns, and long-term effects on loyalty and repeat purchase were not observed. Seller-side effects, such as the redistribution of sales between sellers caused by ranking, were not analysed. Finally, the segment analysis was limited to visitor type.

Conclusion

Merchandising techniques that improve relevance and techniques that raise basket size act through different routes and are complementary. Personalised ranking increased conversion by about 15%, cross-sell bundles raised average order value from ₹1,420 to ₹1,590, and the combination increased revenue per session by 48% over the control. Marketplace operators should combine ranking, listing quality and cross-selling, and evaluate them with randomised experiments and revenue-based metrics. Future research should examine effects on sellers, longer horizons and the interaction of the techniques.

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