# UNANIMOUS A.I.

# Case Study - Sales Forecasting Using Swarm
Customer: Bustle Digital Group (BDG)

## What is Swarm AI?

**Swarm AI™ technology** provides a powerful combination of real-time human insights and AI algorithms, enabling significantly more accurate results than traditional methods.

**Modeled after swarms** in nature, which converge on optimal solutions with extreme efficiency, Swarm AI turns networked human groups into AI-optimized systems, enabling accurate insights to be quickly generated from consumer groups or business teams.

**Applying the power** of Swarm AI is easy using the Swarm platform. It can be accessed from anywhere in the world using standard web browsers and can generate actionable results in a matter of minutes.

**For more information,** visit the following links:

*Swarm AI technology*
https://unanimous.ai/what-is-si/

*Swarm software*
https://unanimous.ai/swarm-for-teams/

*Swarm Insight service*
https://unanimous.ai/swarm-insight/

## Introduction

Bustle Digital Group, the largest publisher for millennial women, used Swarm from Unanimous AI to predict Christmas sales for eight women's sweaters from a major fashion retailer. The Swarm platform generates AI-optimized insights from networked groups of human participants. This effort engaged randomly selected millennial women, each of whom self-identified as being fashion conscious with no sales forecasting experience

> *"Forecasting sales is a big challenge for Fashion Retailers and traditional methodologies based on historical sales data often fall short. With the help of AI, Swarm gives retailers a new secret weapon, allowing them to predict sales more accurately than ever before."*

> *-- Jason Wagenheim*
>    Chief Revenue Officer, Bustle Digital Group

## Method

Participants connected remotely to the **Swarm** platform using standard web browsers on their own personal computers. The participants **watched a 2-minute tutorial** on using Swarm and had an opportunity to ask questions via text-chat to a human moderator. A small set of practice questions were then given to the group to ensure all participants were comfortable with the process and the interface.

The moderator then conducted the formal session, during which time the participants were asked to predict relative **unit sales** (i.e., the ordered sales rank) of eight women's sweaters during the 2018 holiday season. The participants gave assessments first as individuals using an online survey, and then by "thinking together" as an AI-optimized system using Swarm. Specifically, the group used Swarm to rate the sweaters on two critical metrics - **Trendiness** (from 1 to 5) and **Breadth of Appeal** (from 1 to 5).

**Figure 1:** Example of Sweaters for Comparison

# Using Swarm

Swarm is a collaborative intelligence platform for generating AI-optimized insights from networked human groups. The power of Swarm is that the underlying algorithms don't rely on how participants report their sentiments (as reporting can be unreliable and inconsistent), but instead processes how each participant behaves when converging in real-time as part of an interactive system.

This means we can ask questions that appear simple but produce precise answers by evaluating complex human behaviors in real-time. For example, in this study, the participants were asked to rank the predicted sales of eight sweaters. The questions were posed as simple comparisons across a set of sweaters, asking which would sell the fewest units, eliminating that sweater and repeating, until only the highest-ranked sweater remained. But as shown below, each of the simple questions elicited complex behaviors that were processed by swarming algorithms and generated AI-optimized results.



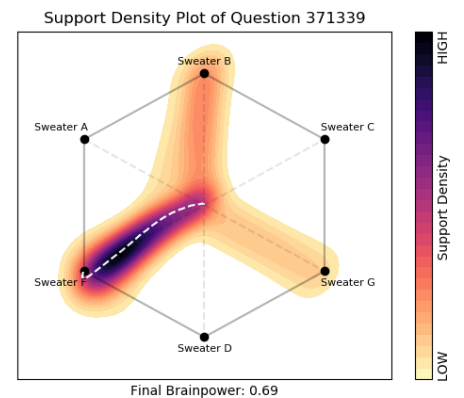Figure 2a: Question, as seen by Participants



Figure 2b: Behavioral Analysis by Swarm AI Engine

As shown above, the image on the left is a snapshot of the 13 participants responding together as a "swarm intelligence" to the question provided. Each magnet is controlled continuously by one of the participants, the position and orientation varying over time as the group deliberates and ultimately converges upon an answer. The image on the right is how the Swarm AI engine views the response of the group during this deliberation, processing their actions, reactions, and interactions in real-time.

## Results

Using the AI-optimized sentiments generated from each Swarm response, the Swarm AI system produced an optimized ranking of the items of clothing. This is an **ordinal ranking** from 1st to Nth, where N is the number of items assessed (in this case, 8 sweaters).
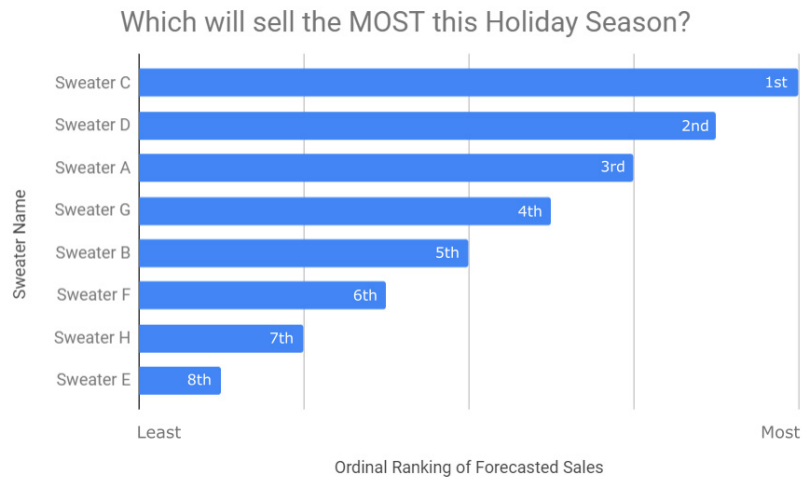
**Which will sell the MOST this Holiday Season?**

| Sweater Name | Ranking |
|---|---|
| Sweater C | 1st |
| Sweater D | 2nd |
| Sweater A | 3rd |
| Sweater G | 4th |
| Sweater B | 5th |
| Sweater F | 6th |
| Sweater H | 7th |
| Sweater E | 8th |

Least — Most

Ordinal Ranking of Forecasted Sales

**Figure 3: Ordered Sales Forecast** (higher indicates more sales)

In addition, a "cardinal ranking" is computed from the system using the underlying behavioral data as the swarm converged on answers. We refer to this as a Scaled Ranking, as it shows the relative spacing between the items. This Scaled Ranking is a linear comparison of each item's forecasted unit sales between the highest-ranked, the lower the Scaled Ranking, the higher the forecasted unit sales.
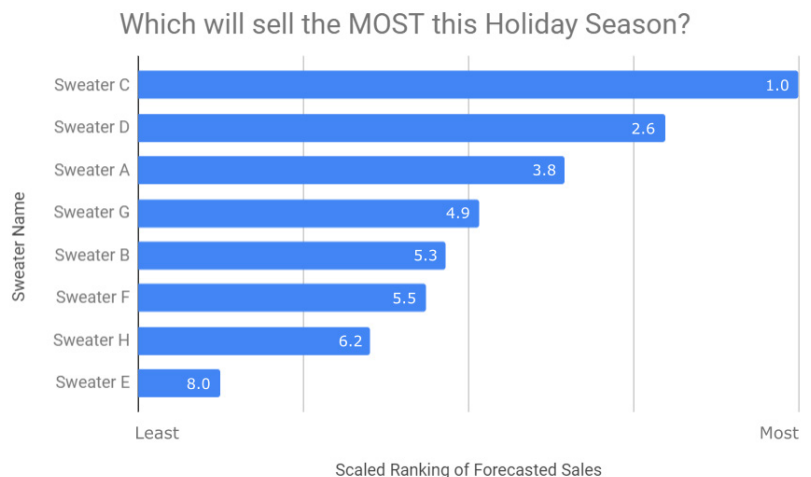
**Which will sell the MOST this Holiday Season?**

| Sweater Name | Scaled Ranking |
|---|---|
| Sweater C | 1.0 |
| Sweater D | 2.6 |
| Sweater A | 3.8 |
| Sweater G | 4.9 |
| Sweater B | 5.3 |
| Sweater F | 5.5 |
| Sweater H | 6.2 |
| Sweater E | 8.0 |

Least — Most

Scaled Ranking of Forecasted Sales

**Figure 4: Scaled Sales Forecast** (higher indicates more sales)

## Results

As shown above, Sweater C was predicted to be the top-selling color by a wide margin, with Sweater A and Sweater D as likely high-sales items. Sweater E was predicted to be the lowest-selling item. The rationale behind the swarm's Scaled Sales Forecast was visualized using the swarm's interpolated ratings of each item's Trendiness and Breadth of Appeal, as shown below. The top three sweaters: Sweater A, Sweater C, and Sweater D, all were rated as having broad appeal, and being moderately to very trendy.
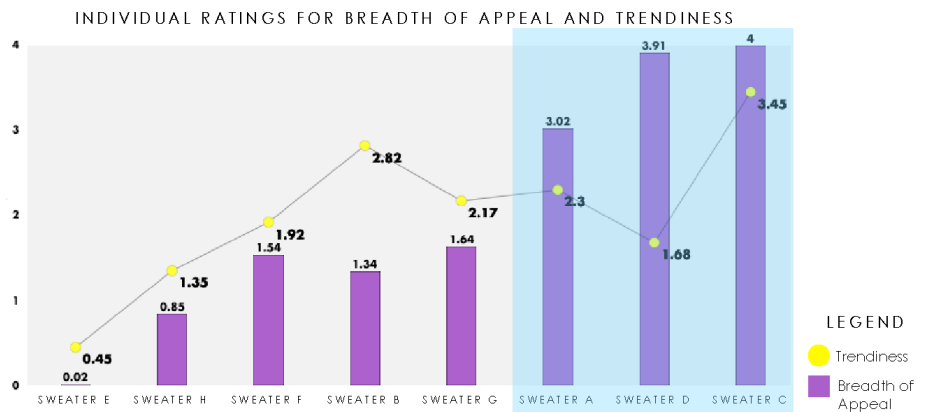


INDIVIDUAL RATINGS FOR BREADTH OF APPEAL AND TRENDINESS

LEGEND
● Trendiness
■ Breadth of Appeal

**Figure 5:** Appeal Comparison

# Performance

**How did the Swarm forecast do compared to actual sales?**

The sales volume of each of the eight sweater styles was reported by the Fashion Retailer and was converted to Scaled Unit Sales (Table 1, Appendix A). The forecasts generated by the Swarm platform were then compared to the true sales data. Comparing the results item by item, Swarm enabled Bustle to correctly predict two of the three top sellers from the group of eight. In addition, if we compare the three items ranked highest by Swarm against the three items ranked lowest, we see that the top three picks outsold the bottom three by a factor of 150% (see Figure 6 below). This is a remarkable result, especially considering that the only difference between the items were color and graphic treatments.
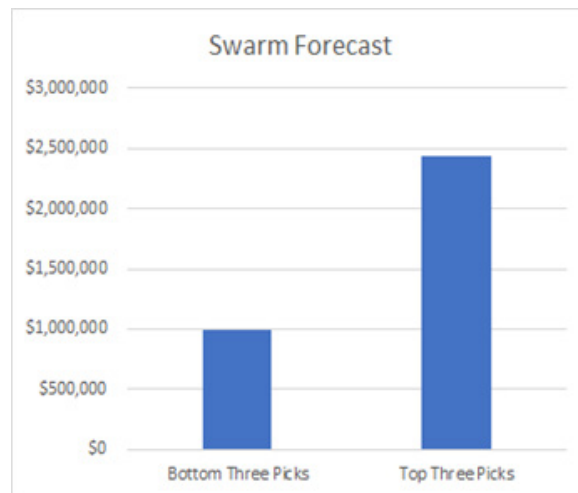


**Figure 6: Comparison of Actual Sales for the Rankings made by Swarm**

But what if we had not used Swarm and had simply asked the participants to provide their forecasts through a traditional online survey? This analysis was done, and it was found that the sales forecasts generated by the Swarm platform were significantly more predictive of the actual Unit Sales Volume than the survey. As shown in Table 2 of Appendix A, the ratings of the Trendiness, Breadth of Appeal, and Scaled Sales Forecast generated by the Swarm platform were highly correlated to actual Unit Sales, successfully predicting 34% of the variance (as compared to only 4% for the survey). This conforms with numerous published academic studies which show that Swarm AI technology elicits significantly more accurate insights from human participants than surveys of equal or far greater size.

# APPENDIX A

## Unit Sales Data

The unit sales data for each of the eight styles is listed below. The Scaled Unit Sales is calculated for each style as the linear ranking of number of units sold (1=most units, 8=fewest units).

| Style | Scaled Unit Sales |
|-------|-------------------|
| Sweater A: | 1.00 |
| Sweater B: | 1.35 |
| Sweater C: | 2.75 |
| Sweater D: | 3.42 |
| Sweater E: | 4.28 |
| Sweater F: | 5.45 |
| Sweater G: | 7.95 |
| Sweater H: | 8.00 |

**Table 1:** Unit Sales Data for Sweater Styles

## Correlation of Ranked Forecasts with Unit Sales

The correlation of each forecast with the actual unit sales is shown below. The average rank of each item by the survey was the least correlated with actual unit sales, indicating that surveying was the least accurate method of forecasting. Each of the three swarm ratings was significantly more correlated with unit sales than the survey. The best performance was seen when these three ratings were combined into a single regression, which explained 34% of the variance in unit sales – a 58% correlation.

| Response Method | Ranking Method | Correlation with Unit Sales | $R^2$ |
|-----------------|----------------|-----------------------------|-------|
| **Survey** | Average Rank | **0.19** | **0.04** |
| **Swarm** | Trendiness Rating | -0.42 | 0.17 |
| | Breadth of Appeal Rating | -0.46 | 0.21 |
| | Scaled Sales Forecast | 0.39 | 0.15 |
| | **Regression over All Data** | **0.58** | **0.34** |

**Table 2:** Forecasted Ranking Correlation with Unit Sales