

Electronidex Market Basket Analysis Report

By: Jessica Krueger & Luca Vehbiu

Executive Summary

Using the Apriori algorithm, we conducted a Market Basket Analysis (MBA) on 9,835 Electronidex's transactions to find insightful association rules in Electronidex's transaction data. Using specific algorithm parameters (support = .002 and confidence = .43), we produced 2,090 association rules. From those 2,090 rules, we highlight 8 rules/patterns that provide the most meaningful insights into Electronidex's transaction data.

From these insights, we provide several recommendations on different product bundles, discounts, and cross-selling opportunities within Electronidex's products. We also provide recommendations for which Electronidex items Blackwell should keep or remove from its inventory.

Finally, we conclude that Blackwell should acquire Electronidex in order to gain access to Electronidex's consumer demographic, unique products, human talent, and distribution resources, while also neutralizing a potential future competitor. Additional recommendations are then given to help improve our ability to perform future market basket analysis.

Insightful Associations and Recommendations

Below is a table displaying the most insightful associations we found and the associated metrics. We've also included a table displaying the importance of each rule and our recommendations based on that rule. In addition to specific association rules, we've also included patterns of association rules that we found in the data. These patterns can lead to more general insights about customers' purchasing behavior.

The Appendix provides more details on the algorithm and parameters used to produce the below association rules and patterns.

Table of Association Rules and Patterns

Rule	LHS	RHS	Support	Confidence	Lift
1	2+ Computers*	Computer	avg: .004	avg: .523	avg: 2.44
2	Dell Desktop, HP Laptop, iMac, ViewSonic Monitor	Acer Aspire	0.004	0.43	5.2 (hyperlift**: 2.64)
3	Computer, Monitor	Apple Magic Keyboard	avg: 0.002	avg: 0.486	avg: 6.78 (hyperlift avg: 2.84)
4	2+ Computers	ViewSonic Monitor	avg: .003	avg: .50	avg: 4.50 (hyperlift avg: 2.4)
5	Apple Product	Apple Earpods	avg: .002	avg: .476	avg: 2.73 (hyperlift avg: 2.1)

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6	Acer Aspire, ViewSonic Monitor, 1+ additional item	HP Laptop	avg: 0.0029	avg: 0.75	avg:4.1 (hyperlift avg:2.3)
7	Dell Desktop, ViewSonic Monitor + 1 item	HP Laptop	avg: 0.0026	avg: 0.76	avg:4.0 (hyperlift avg:2.2)
8	Asus Asus2 Samsung Monitors + 1 or more item	ViewSonic Monitor	avg:0.00238	avg: 0.48	avg: 4.7 (hyperlift avg:2.2)

*In this report, computers are considered either a PC or a laptop

**Hyperlift is an adaptation of the lift measure which is more robust for low counts. The hyperlift measure is included for rules that have low counts (20-40 compared to 9,835 transactions).

Table of Recommendations

Rule	What makes the rule interesting?	Our recommendation
1	There are over 200 rules that have 2+ computers on the LHS and a computer on the RHS. The specific items differ in each rule, but there's a strong pattern based on the product category of computer.	Offer tiered discount system for computers. For example: Buy 3 computers, get 5% off. Buy 4 computers, get 10% off. Buy 5 computers, get 15% off.
2	This is the only rule that includes a non-top-10 item on the RHS.	Promote a discount on the Acer Aspire specifically when 4+ computers or monitors are purchased.
3	There were 4 rules that had a computer and a monitor on the LHS, and Apple Magic Keyboard on the RHS. The lift for these rules was quite high suggesting that the keyboard is much more likely to be purchased along with other computer components than on its own.	Create product bundles that give a small discount if you buy a computer, monitor, and a keyboard.
4	There are 75 rules that have ViewSonic monitor on the RHS. The most important ones (highest lift) have 2+ computers on the LHS. There seems to be a pattern of buying 2+ computers and then buying the ViewSonic Monitor	Offer a discount on ViewSonic monitors when 3 or more computers are purchased.
5	There are 6 rules that include an Apple product on the LHS and Apple Earpods on the RHS. These rules suggest that Apple Earpods are more likely to be purchased with another Apple product than on their own.	Earpods probably have a low price/profit margin, rather than discounting them, we should place them near all other Apple products in the store (as is reasonable). When people buy Apple products online, we should always recommend a pair of earpods.

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6	There are 14 rules that have a combination of Acer Aspire, ViewSonic and 1 or 2 items that lead to the purchase of an HP Laptop. The high lift (corrected for the low count with a more robust metric) means that they are likely to be bought together, which coupled with the high confidence increases the association of these itemsets.	When a customer has Acer and the ViewSonic Monitor on their basket, we could recommend an HP Laptop. This would be a cross-selling opportunity.
7	There are 3 rules where Dell Desktop, ViewSonic Monitor, and 1 additional item leads to an HP Laptop. The confidence and lift metrics are high for these rules.	Same as above, this is a cross-selling opportunity for HP laptops.
8	There are 10 rules that contain monitors on the LHS which lead to the purchase of a ViewSonic Monitor	When a customer puts in the basket one of the monitors mentioned above then suggest a ViewSonic Monitor on discount. We could also offer a tiered discount system on monitors as well.

Additional Insights:

- Electronidex doesn't currently offer extended warranties on their products. Extended warranties have high profit margins, and would be an easy add-on to promote for all purchases of higher priced items.
- When a customer searches for a certain product category (e.g laptop), we could offer a basket full of our top selling (most frequent) laptops and leave them the choice to modify the basket or not.
- During our analysis, we looked at whether or not there were any strong associations within product brands. For example, would the purchase of a product of a certain brand lead to the purchase of another product of the same brand? The only brand association we found was rule #5 above relating to the purchase of Apple Earpods. We didn't find any brand association rules for HP, Dell, Acer, or Asus.
- During our analysis, we found several rules with strong confidence and lift metrics, but the rule itself provided little insight in a business context. Below is an example of such a rule. It seems very unlikely that the purchase of a keyboard/mouse combo and a charging cable would lead to the purchase of a MacBook Air. We excluded rules of this nature from our report due to our inability to draw meaningful conclusions from them.

LHS	RHS	Support	Confidence	Lift
Dell KM117 Wireless Keyboard & Mouse, iPhone Charger Cable	Apple MacBook Air	0.002	0.95	6.12

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Electronidex Products to Sell and to Remove

Items to Sell

Electronidex has three product categories that are not currently carried by Blackwell: smart home devices, speakers, and external hard drives. If the items in these categories are profitable, Blackwell should consider selling these items as well. Smart home devices are especially popular right now, and Blackwell should consider adding this product category to its inventory.

Also, on page 2, we highlight the Electronidex products that are sold most frequently, and we highlight the products that are in product categories that are highly profitable for Blackwell. Special attention should be given to these products when considering which Electronidex products Blackwell should carry. These highlighted products include:

- HP Laptop
- Apple Macbook Air
- Apple MacBook Pro
- ViewSonic Monitor
- Samsung Monitor
- Acer Aspire
- Dell Laptop
- HP Monitor

Items to Remove

Items that have low purchase frequency and a low profit margin should be removed from the inventory. Below is a list of the least frequent items sold by Electronidex (support < .005). However, before removing infrequent items from inventory, we should first analyze the profit margin for each item and the cost of maintaining that item in inventory. If the profit is not worth the cost, then we should remove the items from inventory.

Logitech Wireless Keyboard	VGA Monitor Cable
Panasonic On-Ear Stereo Headphones	1TB Portable External Hard Drive
Canon Ink	Logitech Stereo Headset
Ethernet Cable	Canon Office Printer
Gaming Mouse	Audio Cable
Logitech Multimedia Speakers	5TB Desktop Hard Drive
Roku Express	XIBERIA Gaming Headset
Philips Flexible Earhook Headphone	Samsung Galaxy Tablet

Should Blackwell Acquire Electronidex?

Based on our analysis of Electronidex transactions, as well as the available business opportunities, we believe that Blackwell should acquire Electronidex. Below, we outline the strengths, weaknesses, opportunities, and threats associated with a potential acquisition.

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Strengths

1. Electronidex is an online-only retailer meaning that they have low overhead costs. Acquisition wouldn't add excessive costs to Blackwell's exiting operation. To add to it, being online-only means they have a solid e-commerce structure which would facilitate the synchronization of financial systems and the update of product inventory. (integration of CRM, CMS and ERP systems would depend on the API similarities). To conclude, the future seems to be heading into online-only shops and valuable lessons could be learned from the way that Electronidex does business.
2. Electronidex's most frequently sold item is the iMac which tends to be a very profitable item, even though Apple products generally are not as profitable as other brands. Still, they provide Electronidex with a large customer base.
3. Of Electronidex's 20 most sold items, 8 of those items are laptops or displays. Laptops and displays are 2 of Blackwell's most profitable products as well.

Weaknesses

1. As a startup, Electronidex's operation may not be as mature as Blackwell's. Many start-ups eventually fail, and we need to be sure we're acquiring a business that will continue to be successful.
2. Electronidex is a completely different business model (B2B).
3. The majority of Electronidex's transactions include only one item which might be a concern. Blackwell's customers typically purchase more per transaction, however, as we've seen with Blackwell's data, the amount of items purchased per transaction doesn't have a significant impact on the total amount of the transaction. We should research this further to determine how profitable each of Electronidex's transactions are.

Opportunities

1. Acquisition would give Blackwell **access to new products** and entire product categories not currently sold by Blackwell. Examples include speakers, external hard drives, and smart home devices. Smart home devices in particular are a fast growing product category that Blackwell should add to our inventory in order to remain relevant with consumers.
2. Acquisition would give Blackwell **access to a new demographic** of customers and share of the electronics market. Currently, Blackwell's main demographic is individual consumers while it appears that Electronidex's customer base is businesses. This might be seen as a reason not to acquire since our business models are different. However, this can be seen as a unique business opportunity. By acquiring Electronidex, Blackwell can increase sales and profits by increasing our customer base to include businesses (e.g., corporations, government, and schools) without incurring a significant cost to maintain Electronidex's

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infrastructure. Since Electronidex is a start-up ecommerce company, they have no brick and mortar stores and the associated costs of running such stores.

3. Acquisition would allow Blackwell **access to new distribution resources**. Electronidex is solely an e-commerce company, and by acquiring it, we could utilize their warehousing and distribution resources to help streamline, expand, and improve our e-commerce business.
4. Acquisition would allow Blackwell to **eliminate a potential future competitor** in the market. If, in the future, Electronidex decided to shift their focus to the consumer market, we can neutralize that threat now by acquiring them.
5. Acquisition would allow Blackwell **access to new talent**. Since Electronidex is an e-commerce company, they likely have significant human talent related to digital technology, digital marketing, marketing analytics, e-commerce, etc. By acquiring them, we would also have access to their people who can use their expertise to improve sales and profits at Blackwell.
6. Acquisition would provide Blackwell with **much more in-depth data** which could be used to better understand its customers and offer more opportunities to cross-sell or offer discounts.

Threats

1. The online electronics market is already quite saturated, and by acquiring Electronidex, we may just be acquiring a redundant company that may not thrive in the long run.
2. With very limited information available from Electronidex (only basic transaction data from the past 30 days) it's very hard to know what type of company we would be acquiring. If possible, it would be best to gather additional information about Electronidex and their customers.
3. Without the proper focus on the integration importance it will be very hard to make this acquisition run smoothly.

Additional Recommendations

We provide the following recommendations to further enhance our ability to perform an insightful market basket analysis in the future:

- Electronidex/Blackwell should gather more detailed transaction data that includes product categories, item profit margin, item price, etc and not just the product name. With additional data other than just product names, we can analyze trends in purchases by category, profit margin, price, etc.
- We could perform a more advanced analysis if we had transaction data that included information about when the transaction took place. If we had timestamps for each transaction, we could analyze buying patterns based on the time of day, day of week, month, and so on.

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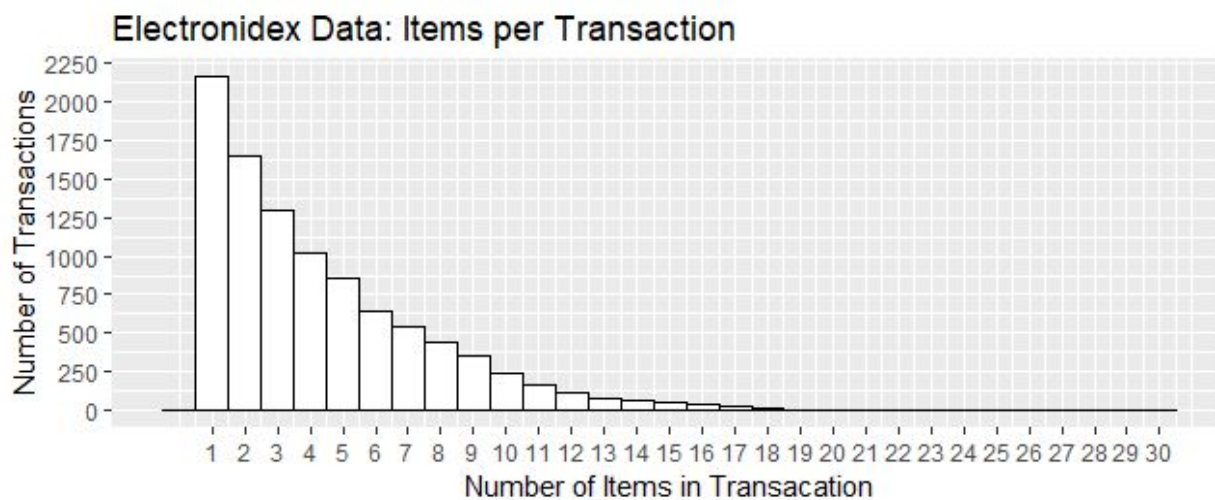
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- Association rules often have underlying factors that can influence the association between products. Underlying factors could be characteristics about the purchaser (e.g., gender, age, profession, location, etc). We can have a better understanding of the association between products if we had additional demographic data about the purchaser for each transaction.
- For future analyses, rather than just having us search for “interesting associations,” if we have a more specific target in mind (e.g., we want to sell more computer monitors), we can look at the data with a target in mind and find more specific associations that can give more actionable insights.
- When providing a list of product names by product category, it’s important that the product names are listed exactly as they are listed in the transaction data. When we attempted to change all of the product names in the transaction data to their product category, we encountered many issues because the product names given on the category list didn’t match the product names used in the transaction data for several items.

Appendix

Overview of Transaction Data

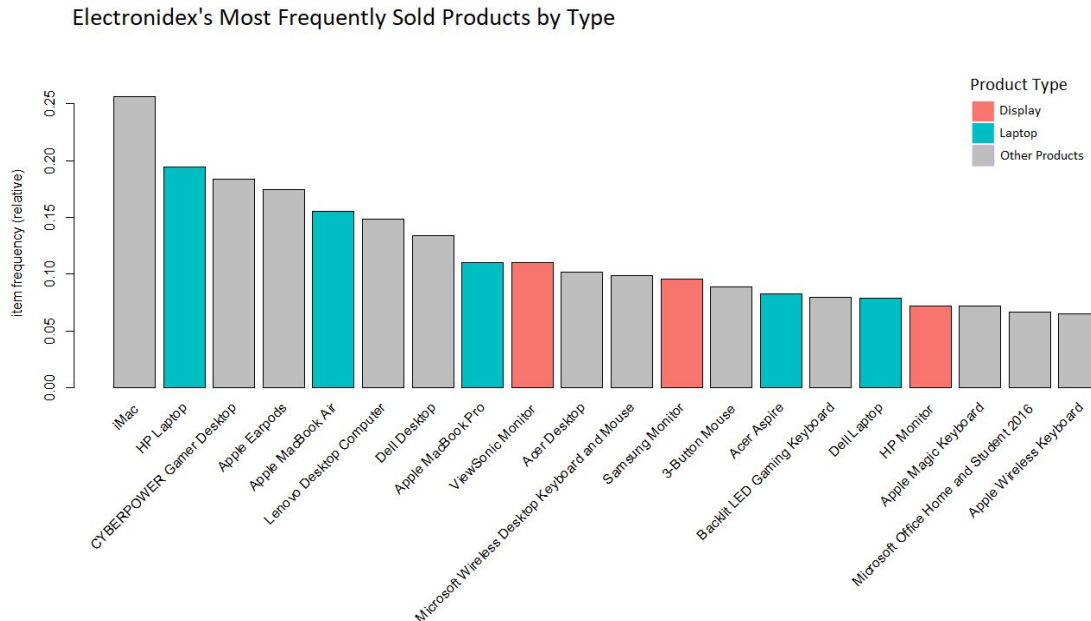
The below graphic displays the distribution of items per transaction in the Electronidex data. Single-item transactions are the most common transaction type. Two-item transactions are the next most common, and so on.



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The below graphic displays Electronidex's 20 most frequently purchased items. Laptops and Displays are highlighted because these are Blackwell's two most profitable product categories.



Algorithm and Parameter Selection

We used the Apriori algorithm which first generates frequent itemsets from the transaction data based on a minimum support threshold and then generates association rules from each frequent itemset based on a minimum confidence threshold.

Apriori Parameters Used

Minimum support threshold: .002

Minimum confidence threshold: .043

Parameter Selection Rationale

Because this data set has a skewed support distribution (see distribution chart below), meaning that most items have low/moderate purchase frequency and a small number of items have a relatively high purchase frequency, we have to be careful about not choosing a support threshold that is too high. With a skewed distribution, a support threshold that is too high will tend to only produce rules that include the high frequency items and we might miss out on meaningful rules that have low support.

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In order to better analyze the rules we checked them for both significance (Fisher's exact test) and redundancy to avoid for spurious cross-pattern associations and rules that had no extra valuable information. The remaining rules after such quality control check was 1,549.

Electronidex Item Support Distribution

