Market Basket Analysis Report

Association Rules for Pizza Restaurant Menu

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Metric	Value
Total Add-on Association Rules	530
Total Item Association Rules	243,430
Unique Ingredients Analyzed	31
High Confidence Rules (>95%)	78
Average Support	23.02%
Average Confidence	85.0%
Average Lift	2.78

1. Introduction

This report presents a comprehensive market basket analysis of a pizza restaurant's ordering patterns. Using association rule mining techniques, we have identified significant relationships between menu items and add-on ingredients that customers frequently purchase together. These insights can drive strategic decisions in menu design, inventory management, promotional offers, and upselling strategies.

Methodology:

The analysis employs the Apriori algorithm to discover association rules between items. Three key metrics are used to evaluate these associations:

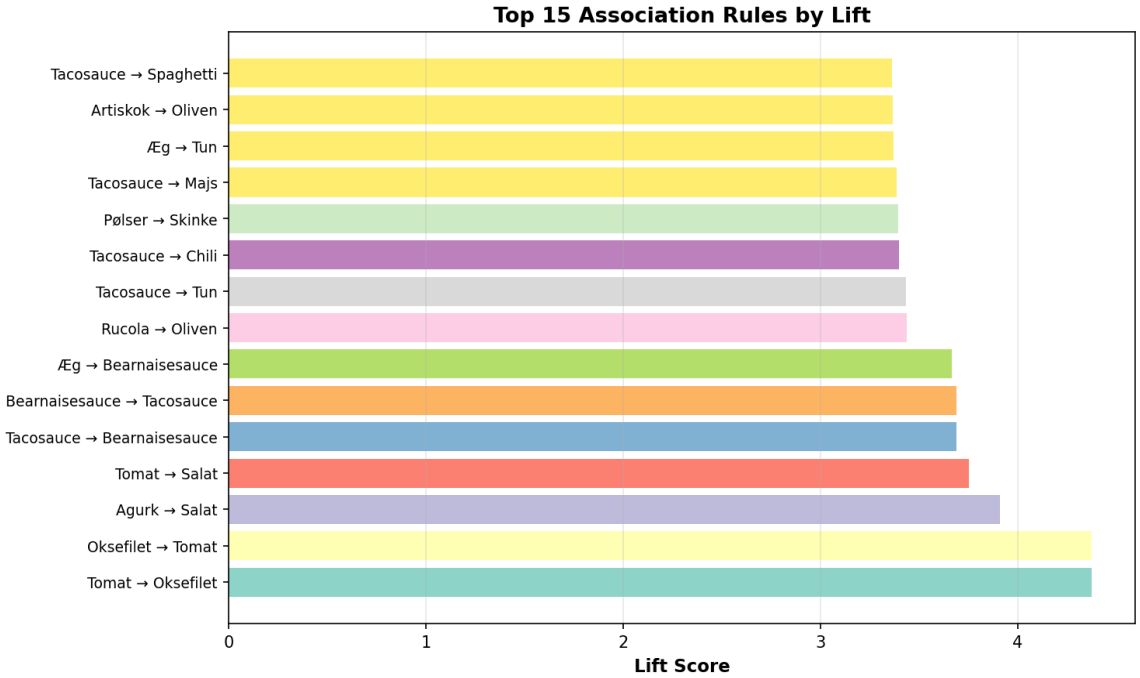
Metric	Definition	Interpretation
Support	Frequency of itemset occurrence	How often items appear together
Confidence	Conditional probability	Likelihood of B given A
Lift	Support(A,B) / (Support(A) × Support(B))	Strength of association (>1 = positive)

2. Key Findings

2.1 Strongest Ingredient Associations

The following ingredient pairs show the highest lift scores, indicating strong positive associations that exceed what would be expected by chance:

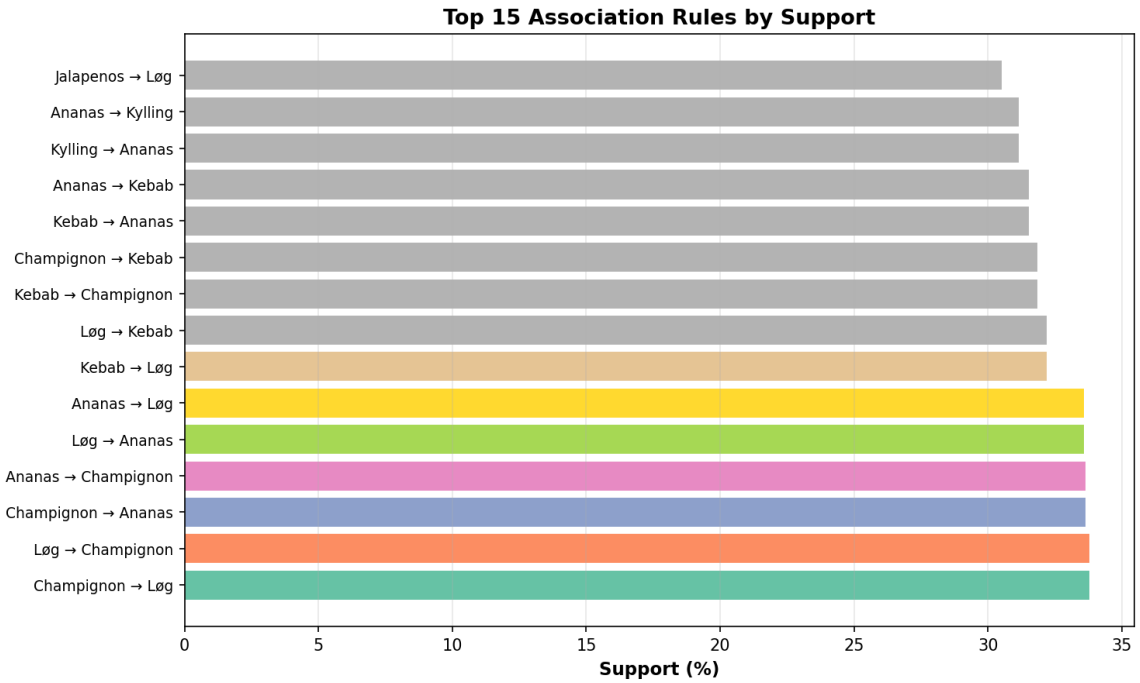
Antecedent	Consequent	Support	Confidence	Lift
Tomat	Oksefilet	15.77%	87.6%	4.38
Oksefilet	Tomat	15.77%	78.7%	4.38
Agurk	Salat	15.11%	98.1%	3.91
Tomat	Salat	16.94%	94.2%	3.75
Tacosauce	Bearnaisesauce	16.02%	84.3%	3.69
Bearnaisesauce	Tacosauce	16.02%	70.1%	3.69
Æg	Bearnaisesauce	15.41%	83.7%	3.66
Rucola	Oliven	15.73%	90.8%	3.44
Tacosauce	Tun	18.03%	94.9%	3.43
Tacosauce	Chili	18.03%	94.9%	3.40



2.2 Most Frequent Combinations

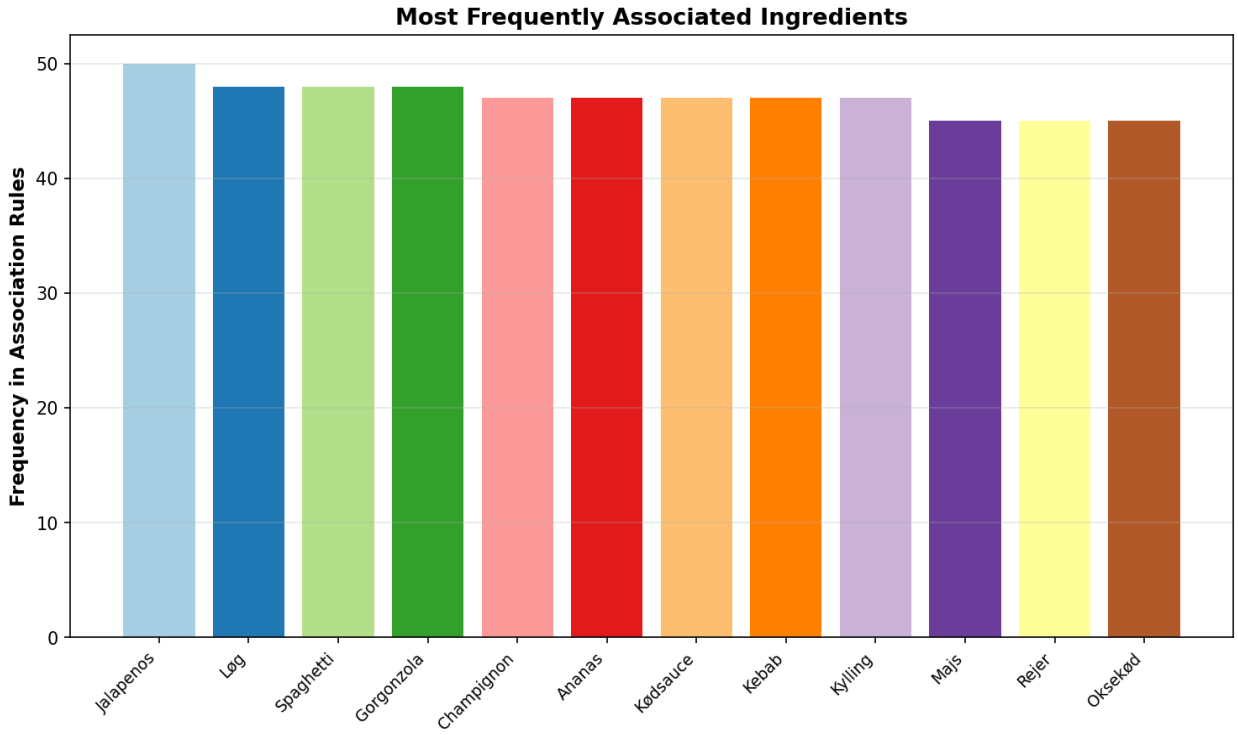
These ingredient pairs appear together most frequently in customer orders, representing the highest support values:

Antecedent	Consequent	Support	Confidence	Lift
Champignon	Løg	33.78%	97.8%	2.82
Løg	Champignon	33.78%	97.4%	2.82
Champignon	Ananas	33.65%	97.4%	2.79
Ananas	Champignon	33.65%	96.4%	2.79
Løg	Ananas	33.59%	96.9%	2.77
Ananas	Løg	33.59%	96.2%	2.77
Kebab	Løg	32.18%	96.2%	2.77
Løg	Kebab	32.18%	92.8%	2.77
Kebab	Champignon	31.84%	95.1%	2.76
Champignon	Kebab	31.84%	92.2%	2.76



3. Ingredient Popularity Analysis

The chart below shows the ingredients that appear most frequently in association rules, indicating their central role in customer ordering patterns:

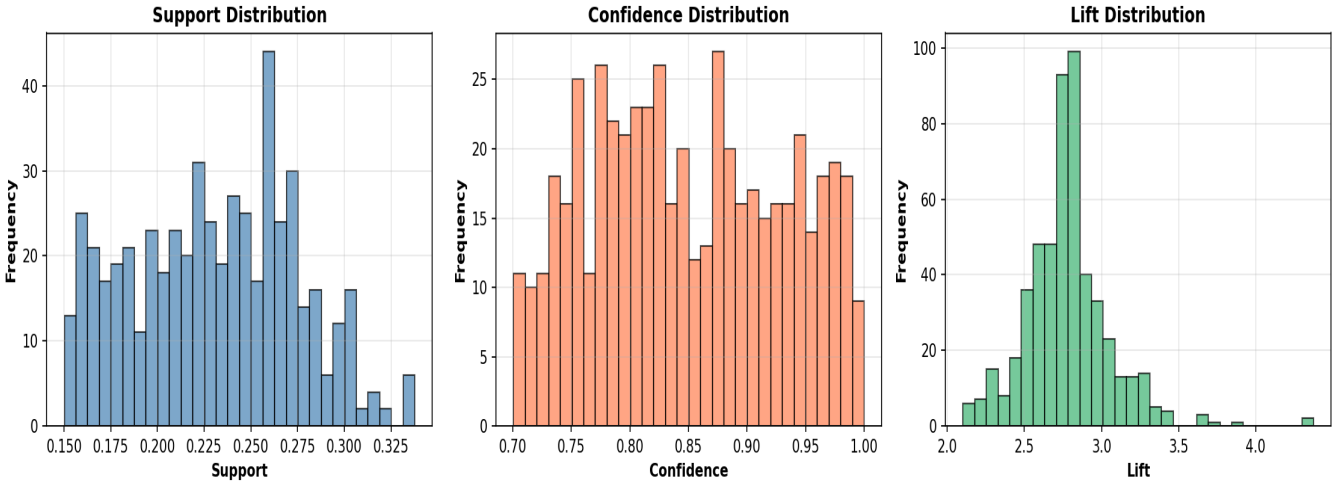


Ingredient	Frequency in Association Rules
Jalapenos	50
Løg	48
Spaghetti	48
Gorgonzola	48
Champignon	47
Ananas	47
Kødsauce	47
Kebab	47
Kylling	47

Majs	45

4. Statistical Distribution of Metrics

Understanding the distribution of support, confidence, and lift scores across all association rules helps identify typical patterns and outliers:



Key Observations:

• **Support:** Most rules have support between 19.5% and 26.2%, with a median of 23.14%

• **Confidence:** The distribution is heavily skewed toward high values, with 163 rules (30.8%) having confidence above 90%

• **Lift:** Lift scores range from 2.10 to 4.38, with most rules showing positive association (lift > 1)

5. Strategic Business Recommendations

5.1 Menu Engineering

Leverage high-lift ingredient associations to create signature pizzas that naturally appeal to customer preferences. For example, the strong associations between Pølser-Bacon and Artichoke-Gorgonzola suggest these combinations should be featured prominently or developed into specialty menu items.

5.2 Upselling and Cross-selling

Train staff to suggest complementary ingredients based on association rules. When a customer orders an item containing one ingredient, recommend the associated ingredient. For instance, when Kødsauce (meat sauce) is ordered, suggest adding Champignon (mushrooms), which appears together in 30.3% of orders with 99.5% confidence.

5.3 Promotional Bundles

Create combo deals featuring frequently paired items at a slight discount to increase average order value. Focus on high-support combinations that already demonstrate strong customer demand.

5.4 Inventory Management

Optimize inventory levels based on ingredient associations. Ingredients that frequently appear together should have proportional stock levels to prevent shortages when one is popular. The analysis reveals 31 unique ingredients that form 530 distinct association patterns.

5.5 Digital Menu Optimization

For online ordering platforms, implement recommendation algorithms based on these association rules. When customers select ingredients, automatically suggest associated items to increase customization and order value.

6. Item-to-Item Association Analysis

Beyond ingredient combinations, the analysis includes 243,430 association rules between complete menu items (pizzas). These rules identify which pizzas are frequently ordered together, valuable for understanding multi-item order patterns and family/group ordering behavior.

Sample Item-to-Item Associations:

Item A	Item B	Support	Confidence
Spinacci	Verona	0.105%	100.0%
Salami Speciale	Ventricina	0.105%	100.0%
Pizza di Salmone	Vesuvio	0.052%	100.0%
Pizza di Salmone	Verona	0.052%	100.0%
Pizza di Salmone	Ventricina	0.052%	100.0%
31-Joy	37-Sorento	0.157%	100.0%
31-Joy	38-Milano	0.157%	100.0%
30-Roma	35-Kims Speciale	0.157%	100.0%
30-Roma	36-Chaplin	0.157%	100.0%
30-Roma	37-Sorento	0.157%	100.0%
30-Roma	38-Milano	0.157%	100.0%
30-Roma	38A. Sucuk	0.157%	100.0%
30-Roma	38B. Sucuk special	0.157%	100.0%
30-Roma	39-Mexico City	0.157%	100.0%
30-Roma	4.Serhat	0.157%	100.0%

Note: Many item-to-item rules show 100% confidence, suggesting strong sequential or complementary purchasing patterns. This data can inform combo meal creation and multi-item promotions.

7. Conclusion and Next Steps

This market basket analysis has uncovered valuable insights into customer ordering patterns at the ingredient and item levels. The data reveals strong, predictable associations that can be leveraged across multiple business functions from marketing to operations.

Immediate Actions:

1. Implement top association rules in POS system prompts for staff upselling

1. Design 3-5 new signature pizzas based on highest-lift ingredient combinations

1. Create promotional bundles featuring high-support ingredient pairs

1. Update online ordering interface with association-based recommendations

1. Adjust inventory management to reflect ingredient co-occurrence patterns

Long-term Opportunities:

• Conduct A/B testing on association-based recommendations to measure revenue impact

• Perform seasonal analysis to identify time-varying association patterns

• Expand analysis to include customer segments for personalized recommendations

• Integrate association rules into automated marketing campaigns

• Monitor changes in association patterns over time to detect trend shifts

Appendix: Complete Association Rules

The following table contains all add-on ingredient association rules, sorted by lift score. This comprehensive list can be used for detailed menu planning and operational decisions.

Antecedent	Consequent	Support	Conf.	Lift
Oksefilet	Tomat	15.8%	79%	4.38
Tomat	Oksefilet	15.8%	88%	4.38
Agurk	Salat	15.1%	98%	3.91
Tomat	Salat	16.9%	94%	3.75
Tacosauce	Bearnaisesauce	16.0%	84%	3.69
Bearnaisesauce	Tacosauce	16.0%	70%	3.69
Æg	Bearnaisesauce	15.4%	84%	3.66
Rucola	Oliven	15.7%	91%	3.44
Tacosauce	Tun	18.0%	95%	3.43
Tacosauce	Chili	18.0%	95%	3.40
Pølser	Skinke	19.5%	100%	3.39
Tacosauce	Majs	17.6%	93%	3.39
Æg	Tun	17.1%	93%	3.37
Artiskok	Oliven	16.7%	89%	3.37
Tacosauce	Spaghetti	18.5%	97%	3.36
Tomat	Majs	16.3%	91%	3.31
Rucola	Oksekød	15.6%	90%	3.31
Oksefilet	Salat	16.6%	83%	3.31
Pølser	Bacon	19.5%	100%	3.30
Æg	Rejer	18.2%	99%	3.29
Pølser	Oksekød	17.4%	90%	3.29
Tacosauce	Oksekød	17.0%	89%	3.28
Rucola	Tun	15.7%	91%	3.28
Artiskok	Spaghetti	17.8%	95%	3.28
Pølser	Dressing	16.4%	84%	3.27
Pølser	Majs	17.4%	90%	3.27
Pølser	Pepperoni	18.4%	95%	3.26
Æg	Chili	16.7%	91%	3.25

Majs	Oksekød	24.2%	88%	3.24
Oksekød	Majs	24.2%	89%	3.24

Antecedent	Consequent	Support	Conf.	Lift
Oksefilet	Oksekød	17.6%	88%	3.23
Tun	Oliven	23.5%	85%	3.22
Oliven	Tun	23.5%	89%	3.22
Oksekød	Bearnaisesauce	19.9%	73%	3.20
Bearnaisesauce	Oksekød	19.9%	87%	3.20
Æg	Oksekød	16.0%	87%	3.19
Tacosauce	Oliven	16.0%	84%	3.19
Artiskok	Gorgonzola	18.5%	99%	3.18
Tomat	Oksekød	15.6%	87%	3.18
Tacosauce	Hvidløg	18.0%	95%	3.18
Majs	Salat	21.8%	80%	3.17
Salat	Majs	21.8%	87%	3.17
Tacosauce	Salat	15.1%	79%	3.17
Bacon	Skinke	28.1%	93%	3.15
Skinke	Bacon	28.1%	95%	3.15
Pepperoni	Skinke	26.8%	92%	3.14
Skinke	Pepperoni	26.8%	91%	3.14
Oksefilet	Oliven	16.6%	83%	3.14
Agurk	Jalapenos	15.1%	98%	3.12
Æg	Spaghetti	16.6%	90%	3.12
Oksefilet	Gorgonzola	19.4%	97%	3.12
Tun	Rejer	25.8%	93%	3.11
Rejer	Tun	25.8%	86%	3.11
Tacosauce	Rejer	17.7%	93%	3.11
Artiskok	Tun	16.1%	86%	3.11
Æg	Jalapenos	17.9%	97%	3.10
Oksefilet	Kødsauce	18.8%	94%	3.08
Majs	Bearnaisesauce	19.3%	70%	3.08
Bearnaisesauce	Majs	19.3%	84%	3.08
Rucola	Spaghetti	15.4%	89%	3.08

Antecedent	Consequent	Support	Conf.	Lift
Rucola	Gorgonzola	16.6%	96%	3.08
Æg	Majs	15.5%	84%	3.07
Spaghetti	Bearnaisesauce	20.3%	70%	3.07
Bearnaisesauce	Spaghetti	20.3%	89%	3.07
Æg	Kødsauce	17.2%	93%	3.07
Oksefilet	Jalapenos	19.3%	96%	3.07
Tacosauce	Kødsauce	17.7%	93%	3.06
Oksefilet	Majs	16.8%	84%	3.05
Tomat	Kødsauce	16.7%	93%	3.05
Oksekød	Salat	20.8%	76%	3.04
Salat	Oksekød	20.8%	83%	3.04
Tomat	Jalapenos	17.2%	95%	3.04
Artiskok	Rejer	17.1%	91%	3.04
Spaghetti	Oliven	23.1%	80%	3.03
Oliven	Spaghetti	23.1%	88%	3.03
Artiskok	Kødsauce	17.3%	92%	3.03
Artiskok	Chili	15.8%	84%	3.02
Kødsauce	Oliven	24.2%	80%	3.02
Oliven	Kødsauce	24.2%	92%	3.02
Bacon	Pepperoni	26.3%	87%	3.00
Pepperoni	Bacon	26.3%	91%	3.00
Oliven	Salat	19.8%	75%	2.99
Salat	Oliven	19.8%	79%	2.99
Salat	Gorgonzola	23.2%	93%	2.98
Gorgonzola	Salat	23.2%	75%	2.98
Tacosauce	Jalapenos	17.8%	94%	2.98
Oliven	Rejer	23.6%	89%	2.98
Rejer	Oliven	23.6%	79%	2.98
Majs	Jalapenos	25.6%	93%	2.98
Jalapenos	Majs	25.6%	81%	2.98