**SCM 518 - ANALYTICAL DECISION MODELING**

**ADVERTISING PERFORMANCE ANALYSIS AND RECOMMENDATIONS**

**KCC COMPANY**

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**About**

KCC Development Inc. is a global e-commerce company specializing in apparel, with headquarters in China and a subsidiary in the United States. Their core market is North America, contributing over 80% of total revenue. In 2023, the company achieved $21,000,000 in global sales. KCC Development operates on major platforms such as Amazon, Temu, and Shein, with ad-driven sales contributing 45% of revenue and organic sales accounting for 55%.  
  






**Operational Challenges**

1. **High Advertising Cost of Sales (ACoS)**: Current ACoS at 22.16% indicates room for improvement in advertising efficiency.
2. **Inconsistent Click-Through Rate (CTR)**: Despite recent improvements, consistency across platforms remains a concern.
3. **Cost-Per-Click (CPC) Management**: Further optimization needed to reduce costs without impacting results.
4. **Conversion Rate (CVR) Optimization**: Crucial for translating clicks into sales.
5. **Resource Allocation**: Inefficiencies in budget distribution and campaign targeting.
6. **Inventory Management**: Current turnover time is 45 days, aiming to reduce to 30 days.
7. **Seasonal Variations**: Need for advanced demand forecasting to manage stock fluctuations.

**The Problem**

KCC Development faces challenges in optimizing advertising performance, including high ACoS, inconsistent CTR, and underutilized CVR. These issues highlight the need for more efficient resource allocation, better campaign targeting, and cost-effective strategies to maximize profitability and growth.

**Objective**

The primary objective is to optimize advertising ROI, enhance inventory turnover, and maximize production efficiency. This involves implementing data-driven decision-making for advertising optimization and production planning, utilizing advanced demand forecasting and inventory management systems to enhance supply chain efficiency.

**Data Visualization Analysis for Cost Reduction Goals**

The analysis of advertising performance for October and November 2024 reveals:

* Ad Spend decreased by 79.22%, from $47,941.92 to $9,961.04
* Ad Revenue dropped by 81.88%, from $248,005.54 to $44,947.75
* Click-Through Rate (CTR) increased by 23%
* Cost-Per-Click (CPC) slightly increased from $0.50 to $0.51
* ACoS rose from 19.33% to 22.16%
* Impressions declined by 83.24%

Weekly trends showed a slight decline in Ad Spend and Ad Revenue but an improvement in CTR (up by 23.68%), and a slight drop in CVR by 2.95%.

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**MATHEMATICAL MODEL**

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**Python Code:**

import gurobipy as gp

from gurobipy import GRB

# Create a new model

model = gp.Model("Revenue\_Optimization")

# Current metrics

current\_ad\_spend = 12418.15

budget\_cap = 50000

current\_ad\_revenue = 57574.23

current\_impressions = 512994

current\_clicks = 24468

current\_ctr = 0.0048 # 0.48%

current\_cpc = 0.51

current\_cvr = 0.0939 # 9.39%

current\_store\_revenue = 130346.20

current\_ad\_revenue\_share = 0.4417 # 44.17%

current\_ad\_spend\_share = 0.0953 # 9.53%

current\_acos = 0.2157 # 21.57%

# Decision Variables

ad\_spend = model.addVar(name="ad\_spend")

total\_revenue = model.addVar(name="total\_revenue")

ad\_revenue = model.addVar(name="ad\_revenue")

store\_revenue = model.addVar(name="store\_revenue")

clicks = model.addVar(name="clicks")

impressions = model.addVar(name="impressions")

production\_costs = model.addVar(name="production\_costs")

in\_house\_production = model.addVar(vtype=GRB.BINARY, name="in\_house\_production")

# Constraints

# Ad Spend Constraints

model.addConstr(ad\_spend <= budget\_cap, "budget\_cap")

model.addConstr(ad\_spend >= 12418.15, "minimum\_spend")

# Revenue Relationships

model.addConstr(ad\_revenue == ad\_spend / current\_acos, "ad\_revenue\_calculation")

model.addConstr(store\_revenue == total\_revenue - ad\_revenue, "store\_revenue\_calculation")

model.addConstr(total\_revenue == store\_revenue + ad\_revenue, "total\_revenue\_calculation")

# Ad Metrics Relationships

model.addConstr(clicks == ad\_spend / current\_cpc, "clicks\_calculation")

model.addConstr(impressions == clicks / current\_ctr, "impressions\_calculation")

# Revenue Share Constraints

model.addConstr(ad\_revenue / total\_revenue == current\_ad\_revenue\_share, "ad\_revenue\_share")

model.addConstr(ad\_spend / total\_revenue == current\_ad\_spend\_share, "ad\_spend\_share")

# Production Cost Calculation

# If in\_house\_production = 1, normal cost; if 0, 10% higher

base\_production\_cost = 0.2 \* total\_revenue # Assuming 20% of revenue as base production cost

model.addConstr(

production\_costs == base\_production\_cost \* (1 + 0.1 \* (1 - in\_house\_production)),

"production\_cost\_calculation"

)

# Non-negativity Constraints

model.addConstr(ad\_spend >= 0, "non\_negative\_ad\_spend")

model.addConstr(total\_revenue >= 0, "non\_negative\_revenue")

model.addConstr(clicks >= 0, "non\_negative\_clicks")

model.addConstr(impressions >= 0, "non\_negative\_impressions")

model.addConstr(production\_costs >= 0, "non\_negative\_production\_costs")

# Objective: Maximize Profit

profit = total\_revenue - ad\_spend - production\_costs

model.setObjective(profit, GRB.MAXIMIZE)

# Optimize the model

model.optimize()

# Print results

if model.status == GRB.OPTIMAL:

print("\nOptimal Solution Found:")

print(f"Ad Spend: ${model.getVarByName('ad\_spend').x:.2f}")

print(f"Total Revenue: ${model.getVarByName('total\_revenue').x:.2f}")

print(f"Production Costs: ${model.getVarByName('production\_costs').x:.2f}")

print(f"In-house Production: {'Yes' if model.getVarByName('in\_house\_production').x > 0.5 else 'No'}")

print(f"Optimal Profit: ${model.objVal:.2f}")

**Comprehensive Conclusion**

**1. Overall Conclusion**

The analysis indicates that while there have been improvements in certain areas like CTR, overall advertising efficiency has decreased, as evidenced by the rise in ACoS and the significant drop in Ad Revenue.

**2. Optimization Conclusion**

The Gurobi Optimizer model provides an optimized production plan for 16 different products, considering factors such as labor hours, cloth usage, selling price, production cost, and advertising spend. This model can help KCC Development make data-driven decisions to maximize profit.

**3. Summary and Outlook**

KCC Development has a strong foundation with its hybrid production system and robust North American market presence. However, there is significant room for improvement in advertising efficiency and inventory management.

**4. Strategic Recommendations**

1. Implement the Gurobi Optimizer model to guide production and advertising decisions.
2. Focus on improving ACoS and CPC for better ROI on advertising.
3. Enhance production efficiency by better utilizing in-house capacity.
4. Reduce inventory turnover time to optimize cash flow and manage seasonal fluctuations.
5. Develop advanced demand forecasting and inventory management systems.
6. Continuously monitor and adjust advertising strategies based on performance metrics.

**Conclusion**

By addressing the identified challenges and implementing the optimization strategies, KCC Development can improve its advertising effectiveness, production efficiency, and overall profitability in the competitive e-commerce apparel market.

**Task Assignment**

1. Marketing Team: Implement and monitor new advertising strategies to improve ACoS and CTR.
2. Operations Team: Utilize the Gurobi Optimizer model for production planning and work on reducing inventory turnover time.
3. IT Department: Develop and implement advanced demand forecasting and inventory management systems.
4. Finance Department: Monitor and analyze the financial impact of the new strategies.
5. Executive Team: Oversee the implementation of strategic recommendations and adjust as necessary based on performance metrics.