Individual Project: Demand Forecasting for A Fast-Food Restaurant Chain

1 Overview

The dataset is provided by one of the largest fast-food restaurant chains in the US. It includes (1) transaction information such as menu items that were purchased and quantities of each item; (2) ingredient lists for individual menu items; (3) metadata on restaurants, including location, and store type. The data observation window is from early March, 2015 to 06/15/2015 and includes transactional data from 2 stores in Berkeley, CA and 2 stores in New York, NY.

Your job is to forecast the daily demand for the next two weeks (from 06/16/2015 to 06/29/2015) to help the managers make inventory replenishment decisions. In particular, you need to forecast demand for one specific ingredient: **lettuce**, for one restaurant with Store ID:46673. You are expected to use both Holt-Winters and ARIMA methods in generating the forecast. The deliverable of the coursework includes a written report (submit both rmd file, and pdf/html file), and the forecast results summarized in a csv file.

Your submission will be evaluated based on the following criteria:

1. Proper application of Holt-Winters model (15%);
2. Proper application of ARIMA model (25%);
3. Performance comparison between Holt-Winters and ARIMA (25%): provide evidence and/or justification to support your arguments;
4. Accuracy of your forecasts (35%).
   (Your results will be compared against the real sales over the two-week period based on mean squared deviation)

2 Data Description

Table 1: pos_ordersale

Column Name	Data Type	Notes
MD5KEY_ORDERSALE	String	Unique identifier for the order in POS
ChangeReceived	Decimal	Change received from the sale
OrderNumber	Integer	Order number, unique to the store
TaxInclusiveAmount	Decimal	Tax amount added to the price of a transaction
posTaxAmount	Decimal	Tax value
MealLocation	Integer	Values:0-Eat in, 1-ToGo
TransactionId	Integer	Transaction ID number
StoreNumber	String	Store number. Corresponds to 'STORE_NUMBER' in store_restaurant
date	Datetime	Date of the transaction

Row description: Franchisee point of sale transaction

Table 2: menuitem

Column Name	Data Type	Notes
MD5KEY_MENUITEM	String	Unique identifier for the purchased menu item
MD5KEY_ORDERSALE	String	Unique identifier for the POS order Corresponds to 'MD5KEY_ORDERSALE' in pos_ordersale
StoreNumber	Integer	Store number Corresponds to 'STORE_NUMBER' in store_restaurant
date	Datetime	Date of the transaction
TaxInclusiveAmount	Decimal	Tax amount added to the price of an item
TaxAmount	Decimal	Tax value
AdjustedPrice	Decimal	Price of the item after discount adjustment
DiscountAmount	Decimal	Amount of discount
Price	Decimal	Original price
Quantity	Integer	Quantity of the purchased item
PLU	Integer	Unique identifier for the recipe associated with this menuitem Corresponds with 'PLU' in menu_items
CategoryDescription	String	Item category description (hierarchy of 3 levels)
DepartmentDescription	String	More detailed item description
Description	String	Most detailed item description
Id	Integer	Unique identifier for associated menu item in menu_items

Row description: Purchased menu item associated with a single transaction in pos_ordersale
Remark: Purchased menu items in menuitem are matched to menu items in menu_items on menuitem.PLU and menuitem.Id and menu_items.PLU and menu_items.MenuItemId.

Table 3: store_restaurant

Column Name	Data Type	Notes
STORE_NUMBER	String	Unique identifier for the store
STORE_ADDRESS1	String	First line of store address
STORE_ADDRESS2	String	Second line of store address
DISTRIBUTION_REGION	String	Store's region
STORE_STATE	String	Store's state
STORE_ZIP	String	Store's zip code
STORE_TYPE	String	Indicates type of store

Row description: A store (or restaurant) location

Table 4: menu_items

Column Name	Data Type	Notes
MenuItemId	Integer	Unique identifier for the menu item
MenuItemName	String	Abbreviated description of the menu item
MenuItemDescription	String	Detailed description of the menu item
PLU	String	Unique identifier for the recipe associated with this menu item
RecipeId	Integer	Unique identifier for the recipe. Corresponds with 'RecipeId' in recipes

Row description: A menu item associated with a franchisee recipe
Remark: Purchased menu items in menuitem are matched to menu items in menu_items on menuitem.PLU and menuitem.Id and menu_items.PLU and menu_items.MenuItemId

Table 5: recipes

Column Name	Data Type	Notes
RecipeId	Integer	Unique identifier for the recipe
RecipeName	String	Abbreviated name of the recipe
RecipeDescription	String	Full name of recipe

Row description: A recipe for a menu item

Table 6: recipes_ingredient_assignments

Column Name	Data Type	Notes
RecipeId	Integer	Unique identifier for the recipe. Corresponds with 'RecipeId' in recipes
IngredientId	Integer	Unique identifier for the ingredient. Corresponds with 'IngredientId' in ingredients
Quantity	Decimal	Quantity of specific ingredient used in that recipe

Row description: A single recipe

Table 7: recipe_sub_recipe_assignments

Column Name	Data Type	Notes
RecipeId	Integer	Unique identifier for the recipe. Corresponds with 'RecipeId' in recipes
SubRecipeID	Integer	Unique identifier for the sub-recipe. Corresponds with 'SubRecipeID' in sub_recipes
Factor	Decimal	Quantity of specific SubRecipeID used in RecipeID

Row description: A single sub-recipe

Table 8: sub_recipes

Column Name	Data Type	Notes
SubRecipeId	Integer	Unique identifier for the sub-recipe
SubRecipeName	String	Name of sub-recipe
SubRecipeDescription	String	Description of sub-recipe

Row description: Sub-recipe associated with a recipe

Table 9: sub_recipe_ingr_assignments

Column Name	Data Type	Notes
SubRecipeId	Integer	Unique identifier for the sub-recipe. Corresponds with 'SubRecipeId' in sub_recipes
IngredientId	Integer	Unique identifier for the ingredient. Corresponds with 'IngredientId' in ingredients
Quantity	Decimal	Quantity of ingredient used in the sub-recipe

Row description: A single ingredient within a sub-recipe

Table 10: ingredients

Column Name	Data Type	Notes
IngredientId	Integer	Unique identifier for the ingredient
IngredientName	String	Ingredient full name
IngredientShortDescription	String	Ingredient short description
PortionUOMTypeId	Integer	Portion unit of measure Corresponds with 'PortionUOMTypeId' in portion_uom_types

Row description: An ingredient used in a franchisee recipe

Table 11: portion_uom_types

Column Name	Data Type	Notes
PortionUOMTypeId	Integer	Unique identifier for the unit of measurement
PortionTypeDescription	String	Text description of unit of measurement

Row description: Portion (or unit of measurement) for an ingredient