1) In this problem, we used the **Apriori** technique to mine association rules.

Justification for using Apriori: We need to find the tuples with (Student ID Group, Time Slot, Item ID) such that the penalty incurred is minimum. For this, we are applying Association Rule Mining to find the rules having most number of transactions where an item is the most frequently brought by a particular student group in a particular time slot.

We process separately on each of August, September, October, and November. In each of these months, we had to do some basic pre-processing to identify the group to which the student belongs to and to which hour the transaction belongs to. After this, we defined a term : (Quantity/ Segment_weight) , based on which further processing was done. The basic idea was to include only those rules above a certain threshold which are contributing more to the revenue and less to the penalty. This value had to be manually adjusted to get the most optimal rules. All entries with this quantity/segment_weight above 3.6 were considered for further prcessing.

Then we created a presence-absence table with the following entries –Student ID group, Time slots and all the items. This generates a field for each of the hours, student groups and the items present in the menu which can either be (T/F). We then used Apriori on this input with consequents as Item Name and antecedents as a tuple- (Time slot, Student Group) to find out which are the most frequently sold items for a given Time slot and Student Id Group. We arrive at the rules. However, we only consider those rules with both Student Id group and Time Slot in the antecedent. In order to get a revenue increase of 5%, the support and confidence percentages were manually set.

We then take all the rules which were formed and use a python code (1.py) to find out the penalty sum and revenue change along with the number of groups.

The final results are as follows:-

- Increase in revenue – **5.02%**
- Penalty incurred – **82402**
- Number of rules included – 285

Strengths: Apriori gives good results in this case as even those with high revenue, low quantity will be considered.

Weakness: There is no particular check on penalty and no discouragement when we add repeated hours for a given id group and item which results in a non-optimal penalty.

The final output is present in the newPrices.csv file