Question 1

Assumptions:

- Customer spending habits differ by game, so we must control for it
- Assume that the average price point for an item in each game is the weighted average of all actual prices, weighted by the demand.
- Assume the occurrence of discounts on 1 item does not depend on occurrence of discounts of another item

Note that the response variable for all the following models is ln(demand), and weighted_actual_price is the natural log of the prices. The weighted average of prices is calculated for every game, and weighted on the demand. The full calculations are found in the accompanying Jupyter Notebook.

Nacho:

- Model:
    - 1.267 + 1.49 * weighted_actual_price + -0.009 * Discount_HotDog + -0.421 * Discount_SouvCup + 0.447 * Discount_BtlWater + 1.193 * Discount_Peanuts + -0.021 * Discount_Pretzel + 0.057 * Discount_Popcorn + 1.193 * game_week_Game 2 + 0.514 * game_week_Game 3 + -0.374 * game_week_Game 4 + 0.105 * game_week_Game 5 + -0.535 * game_week_Game 6 + -0.991 * game_week_Game 7 + -0.048 * game_week_Game 8
- Elasticity: 1.489932

Souvenir Popcorn:

- Model:
    - 0.927 + 0.765 * weighted_actual_price + -0.359 * Discount_HotDog + 1.272 * Discount_SouvCup + 0.506 * Discount_BtlWater + -0.049 * Discount_Peanuts + -0.049 * Discount_Nachos + -0.304 * Discount_Pretzel + -0.049 * game_week_Game 2 + -0.7 * game_week_Game 3 + 0.31 * game_week_Game 4 + 1.638 * game_week_Game 5 + 0.397 * game_week_Game 6 + -0.469 * game_week_Game 7 + 0.803 * game_week_Game 8
- Elasticity: 0.764872

Hot Dog:

- Model:
    - 2.373 + 1.919 * weighted_actual_price + 0.476 * Discount_SouvCup + 2.125 * Discount_BtlWater + -0.323 * Discount_Peanuts + -0.323 * Discount_Nachos + -1.332 * Discount_Pretzel + -0.639 * Discount_Popcorn + -0.323 *

game_week_Game 2 + 0.221 * game_week_Game 3 + -0.211 * game_week_Game 4 + -0.544 * game_week_Game 5 + -1.553 * game_week_Game 6 + 0.894 * game_week_Game 7 + -0.096 * game_week_Game 8

- Elasticity: 1.918896

Peanuts:

- Model:
    - 1.499 + 1.743 * weighted_actual_price + 0.157 * Discount_HotDog + -0.147 * Discount_SouvCup + 0.324 * Discount_BtlWater + 0.993 * Discount_Nachos + 0.104 * Discount_Pretzel + -0.085 * Discount_Popcorn + 0.993 * game_week_Game 2 + 0.412 * game_week_Game 3 + -0.004 * game_week_Game 4 + 0.245 * game_week_Game 5 + -0.308 * game_week_Game 6 + -0.474 * game_week_Game 7 + -0.329 * game_week_Game 8
- Elasticity: 1.742677

Pretzels:

- Model:
    - 2.013 + 1.818 * weighted_actual_price + -0.798 * Discount_HotDog + 0.756 * Discount_SouvCup + 0.965 * Discount_BtlWater + -0.089 * Discount_Peanuts + -0.089 * Discount_Nachos + -0.631 * Discount_Popcorn + -0.089 * game_week_Game 2 + 1.94 * game_week_Game 3 + 0.016 * game_week_Game 4 + -0.25 * game_week_Game 5 + 1.21 * game_week_Game 6 + -0.553 * game_week_Game 7 + -0.381 * game_week_Game 8
- Elasticity: 1.818025

Bottled Water

- Model:
    - 2.985 + 2.026 * weighted_actual_price + 1.985 * Discount_HotDog + -1.243 * Discount_SouvCup + -0.153 * Discount_Peanuts + -0.153 * Discount_Nachos + 0.925 * Discount_Pretzel + 0.385 * Discount_Popcorn + -0.153 * game_week_Game 2 + 0.132 * game_week_Game 3 + -0.059 * game_week_Game 4 + 0.228 * game_week_Game 5 + 0.793 * game_week_Game 6 + -1.76 * game_week_Game 7 + 0.157 * game_week_Game 8
- Elasticity: 2.025599

Souvenir Soda

- Model:

- 1.932 + 1.947 * weighted_actual_price + 0.577 * Discount_HotDog + -0.591 * Discount_BtlWater + -0.051 * Discount_Peanuts + -0.051 * Discount_Nachos + 0.933 * Discount_Pretzel + 1.149 * Discount_Popcorn + -0.051 * game_week_Game 2 + 1.283 * game_week_Game 3 + 0.196 * game_week_Game 4 + 0.472 * game_week_Game 5 + -0.349 * game_week_Game 6 + 0.818 * game_week_Game 7 + 0.677 * game_week_Game 8
- Elasticity: 1.946914

Question 2

See Jupyter Notebook

Question 3

	item	elasticity
0	Nachos	1.489932
1	Souv Popcorn	0.764872
2	Hot Dog	1.918896
3	Peanuts	1.742677
4	Pretzels	1.818025
5	Bottled Water	2.025599
6	Souv Soda 32oz	1.946914

Souvenir popcorn has a price elasticity of demand lower than 1, which makes it an inelastic good. This means that, after controlling for the game week and existence of discounts of other items, souvenir popcorn seems to be a "necessity" without substitutes to the consumer. However, we must note that this analysis is conducted by analyzing the price change vs demand change over the 8 game weeks. What this means is that, holding all else equal, souvenir popcorn is, on average, an inelastic goods; the price changes over the 8 weeks did not cause the demand to change significantly.

With this information, the Bears can be more flexible in their pricing of souvenir popcorn, while not increasing prices of the others so much. However, because we added game week as a control, the Bears can also look at how game week affects the elasticity of goods.

Also, with the information presented in question 2, the Bears can look at how the existence of discounts on other items affects the demand of one item, as well as how the game week affects the demand of an item. By combining these 2 pieces of information, the Bears can develop a better pricing strategy by optimizing the co-occurence of discounts to maximize demand and thus maximize sales. Another possible use of this information is that the Bears can optimize inventory by looking at how the demand varies by game week.

Question 4

Weakness

- The demand and price is split by game week. By doing so, we are essentially looking at 1 single price point (albeit weighted) for every game week. This means that we are assuming the price varies by game, and thus price affects demand. The downfall of this assumption is that there can be variations of price within the same game week that cause variations in demand, but we fail to account for that in this simplification.
- Because of splitting by game week, we only have 8 data points to build a linear regression on and to find the price elasticity. With so few data points, it is hard to find a good estimate of the actual value of the coefficient itself.
- Another weakness is that there are too few sources of variation. For instance, only a tiny fraction of customers are club-level with a 20% discount. It is difficult to gauge demand for that 20% discount price point.

Solution

- Since the discounts are already only redeemable on the app with QR code, the Bears could send out random discounts to the app holders of varying percentages to gather more data on how demand varies at different price points.
- The Bears should also include the sales of the non STH or CL customers to see if no discount changes the demand. This also adds more data by incorporating demands at the original price point.
- For each game, the Bears should also include who they're playing against. The attendance of the games can vary depending on the excitement of the game, which is likely dictated by the Bears' opponent of a given game. Attendance can also heavily affect the demand for food items, and should thus be added as a control variable.