Question 1

a. Recall from the notes that people make 2 mistakes when trying to randomize: they switch too often and the try too hard to ensure that all possible outcomes occur. Here the firm is trying too hard to ensure that every possible day of the week occurs. If the sale dates were truly random, some days would repeat.

b. The customer should shop on Sunday. By realizing the firm is trying too hard to make sure all possibilities occur, the firm becomes predictable. Here the customer predicts Sunday, because that is the only day that has not yet occurred.

Question 2

a. Intel could add to capacity, making it cheaper to build a large number of chips and more expensive to build a smaller number of chips. Intel must decrease prices to sell all the chips, which will deter entry by NEC.

b. In general, the supplier needs to put up some initial funds, which can be refunded when the supplier fulfills it's end of the contract. Surety bonds have this flavor. The supplier pays an insurance company that will pay Apple if the supplier does not fulfill it's obligations. Other good answers are having many suppliers or building up an inventory of parts.

c. Folgers could enter the West Coast market, tying up Maxwell House's resources and thus preventing Maxwell House from entering on the East Coast. Folgers could also try to line up exclusive distribution rights with suppliers and retailers. Folger's could launch an ad campaign on the East Coast to strengthen it's brand, making entry for Maxwell House less attractive.

d. The union can build a strike fund, build media support for a strike, build membership or ally with a large union that could help the union member survive a strike, or delegate the strike decision to an agent, such as a larger union.

e. Home Depot could move first and locate even in marginal towns, thus preventing other hardware chains from building the large number of stores required to take advantage of economies of scale.

Question 3

a. The sequential game when Harley moves first is:

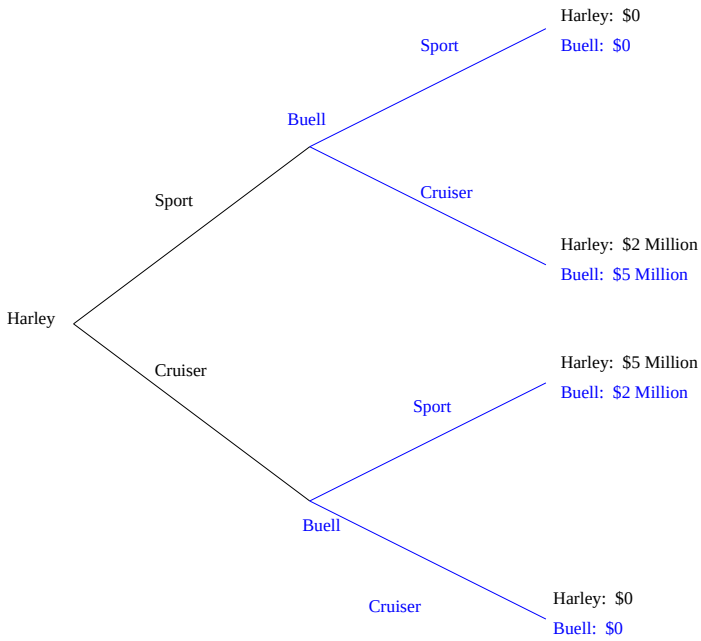

Figure 1: Anti-coordination game in sequential form: Harley moves first.

Using the circle method, the sub game perfect equilibrium occurs when Harley enters the cruiser market and Buell enters the sport market. Harley knows if they enter the more profitable cruiser market first, then Buell is better off moving into the sport market than starting a price war in the cruiser market.

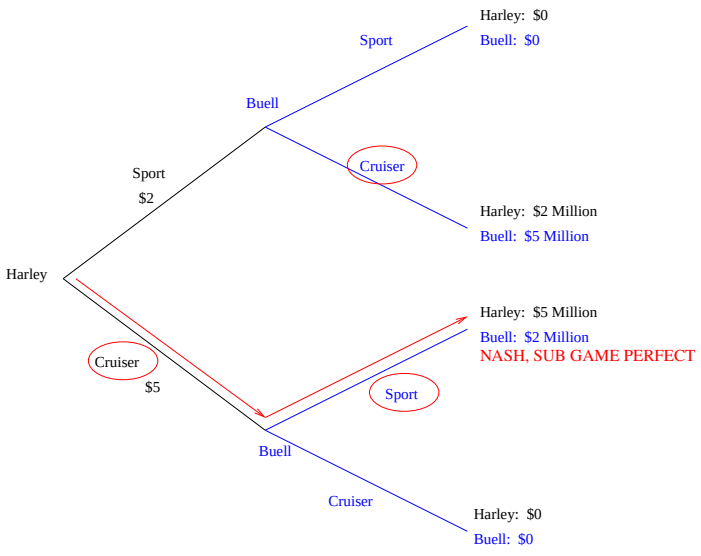

Figure 2: Harley moves first: sub-game perfect equilibrium.

b. Suppose Buell makes a (non-credible) threat to enter the cruiser market if Harley enters

the cruiser market. If Harley believes the threat, they enter the sport market, and so Buell enters the cruiser market. We have a Nash equilibrium which is not sub game perfect since the threat is off the equilibrium path: we never get to see if Buell would have carried out the threat.

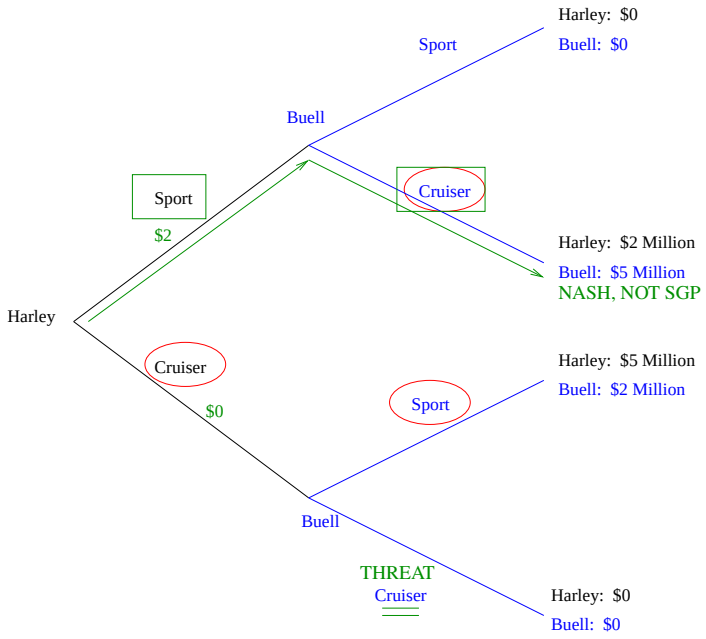

Figure 3: Harley moves first: Nash equilibrium which is not sub-game perfect.

c. As seen in figure 4, the equilibrium reverses: the sub game perfect equilibrium is where Buell gets the sport bike business.

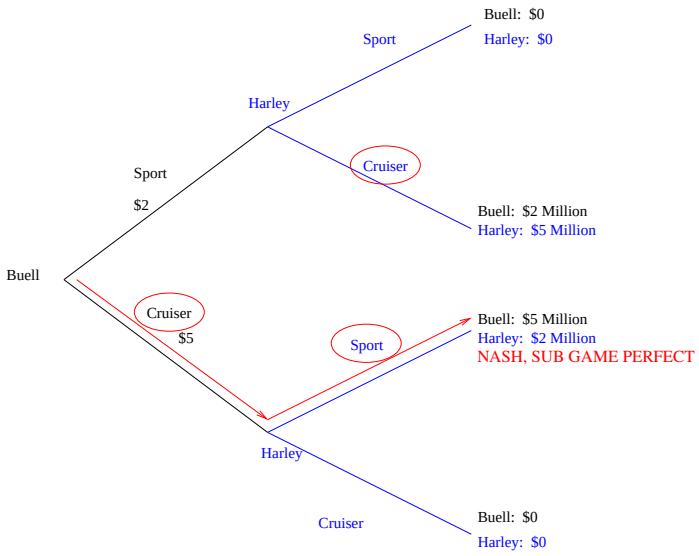

Figure 4: Buell moves first: sub-game perfect equilibrium.

d. Again, the equilibrium reverses, and Harley must now make the non-credible threat to get it's preferred equilibrium.

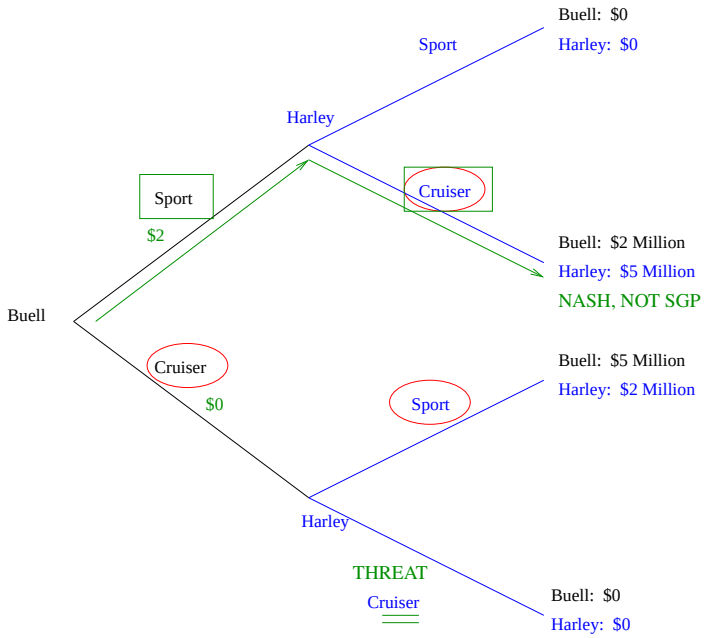

Figure 5: Buell moves first: Nash equilibrium which is not sub game perfect.

e. Yes, the first mover gets to move into the most profitable business. The second mover can only get their preferred equilibrium by making non-credible threats and hoping the first mover takes them seriously.

Question 4

a. Using the circle method, no pure strategy Nash equilibria exist.

		National Company	
		Inspect	Don't Inspect
Franchise	High effort	(10),15	2,(18)
	Low effort	2,(1)	(10),0

Table 1: Inspection game.

b. For the mixed strategy, follow the steps:

- Step 1: Suppose the National Company predicts the Franchise will exert high effort with probability q. For this prediction to eventually be correct, the national company must be indifferent between inspecting and not. We have:

$$\text{Payoff, Inspect } = 15q + 1 \cdot (1 - q), \tag{1}$$

$$= \text{ Payoff, Don't Inspect } = 18q + 0 \cdot (1 - q), \tag{2}$$

$$15q + (1 - q) = 18q, \tag{3}$$

$$3q = 1 - q, \ \rightarrow \ q = \frac{1}{4}. \tag{4}$$

  This makes sense: the national company prefers not to spend the resources inspecting (average benefit of inspecting is $(15 + 1)/2 = 8$, whereas the average benefit of not inspecting is $(18 + 0)/2 = 9$). So the franchise can exert low effort more often ($q < \frac{1}{2}$) until the firm becomes indifferent between inspecting or not.

- Step 2: Given that the franchise exerts high effort with probability one fourth, we need to get the optimal strategy of the national company. The franchise must be indifferent between strategies. Otherwise, the franchise will always exert high effort (or not) and the national company will always not inspect (or inspect) and the equilibrium will break down. Suppose the franchise believes the national company will inspect with probability p. Then the payoff to the franchise is:

$$\text{Payoff, high effort } = 10p + 2(1 - p), \tag{5}$$

$$= \text{ Payoff, low effort } = 2p + 10(1 - p), \tag{6}$$

$$10p + 2(1 - p) = 2p + 10(1 - p), \tag{7}$$

$$8p = 8\,(1-p)\,, \quad \rightarrow \quad p = \frac{1}{2}. \tag{8}$$

This makes sense, the franchise is indifferent between high and low effort on average ($(10+2)/2 = 6$ for either high or low effort). Since the franchise does not have any particular preference, the national company must inspect with probability one half.

The mixed strategy equilibrium is: the franchise puts in high effort with probability one fourth and the national company inspects with probability one half.

c. No, the franchise only puts in high effort one quarter of the time. To get the franchise to put in high effort more often, the national company would have to inspect more often. But then the franchise would always put in high effort and then the national company would not want to waste resources and put in low effort, and so on.

Instead, it is the fact that the national company prefers not to waste valuable resources conducting inspections that results in low effort by the franchise. The franchise knows the company does not want to inspect unless it is necessary, and so the franchise can get away with low effort most of the time.

Question 5

a. Collecting all the information gives the following extensive form of the game:

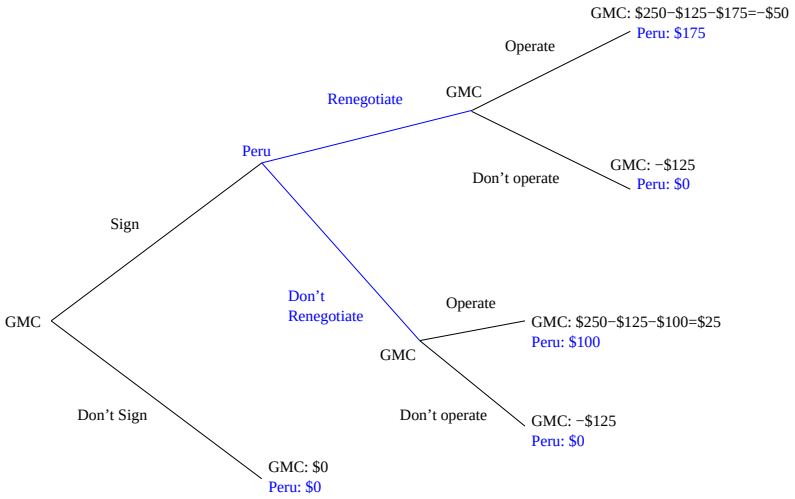

Figure 6: The hold up problem.

b. Using the circle method working backwards:

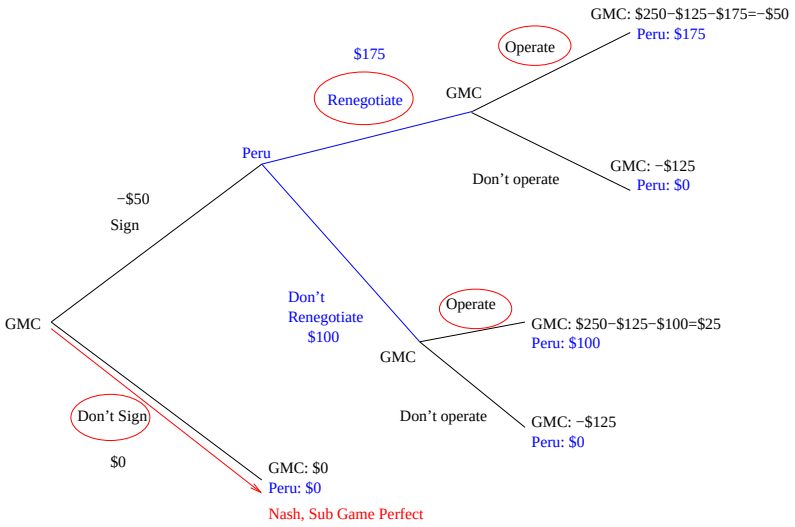

Figure 7: The hold up problem.

In the sub game perfect equilibrium, GMC does not sign. Both players lose out because Peru will be unable to restrain itself from taking too much of the pie once the mine is built. Once the mine is built, GMC might as well operate it, because operating the mine gives $250 in gross profits, and the cost of the mine is sunk. So for any amount of taxes less than $250, GMC will operate the mine. Anticipating that Peru will renegotiate, GMC does not build the mine.

c. No. If ever in that situation, GMC would operate the mine, as it is better to get some gross profits out of the mine, even if they do not completely pay off the fixed costs.

d. Let us consider first the possibility that GMC threatens not to operate the mine if GMC renegotiates. We have:

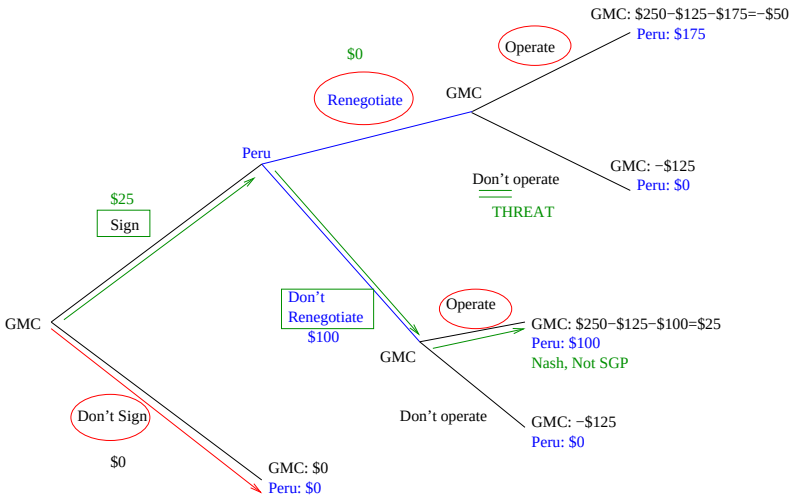

Figure 8: The hold up problem.

If Peru believes the threat, Peru will not renegotiate and GMC earns enough profits from operating the mine to pay off the fixed costs. Therefore, GMC builds the mine. This is a better outcome for both players, but unfortunately relies on the unlikely possibility that Peru will believe GMC's non-credible threat.

A second possibility is that Peru makes a promise not to renegotiate the contract. However, this will not lead to a Nash equilibrium: if GMC believes the promise and enters the market, Peru will renegotiate the contract and the prediction that Peru would not renegotiate is not confirmed. The problem is that the promise is on the equilibrium path.

The same problem occurs if GMC threatens to not operate the mine if Peru does not renegotiate.

e. No, the promise is on the equilibrium path, so if GMC predicts Peru will not renegotiate, this promise will not come true.

f. The threat is not credible, but Nash equilibria that are not sub game perfect allow non-credible threats.

g. The solution is for Peru to put up some money up front (perhaps through a surety bond) that is forfeited if Peru renegotiates the contract.

Question 6

a. We have:

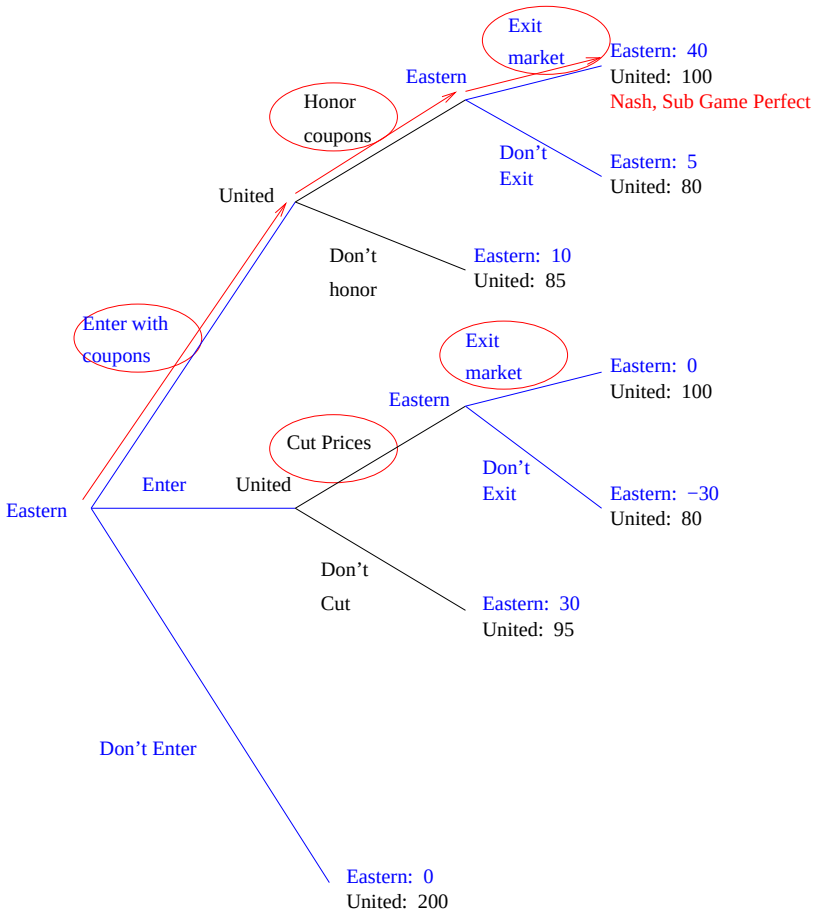

Figure 9: Eastern Airlines.

The sub-game perfect equilibrium has Eastern entering with coupons, knowing that United will honor the coupons, in which case Eastern exits the market.

b. The obvious choice is for United to threaten not to honor the coupons. However, this is not a Nash: even if Eastern believes the threat, it will still enter with coupons. Since the threat is on the equilibrium path, United will honor the coupons and the belief is not correct.

United could also promise not to cut prices if Eastern enters without coupons. However, even if Eastern believes this promise, it will want to enter with coupons, leading to the sub-game perfect equilibrium.

Eastern, however, could make some threats in the third round. Eastern could promise not to exit if United honors the coupons:

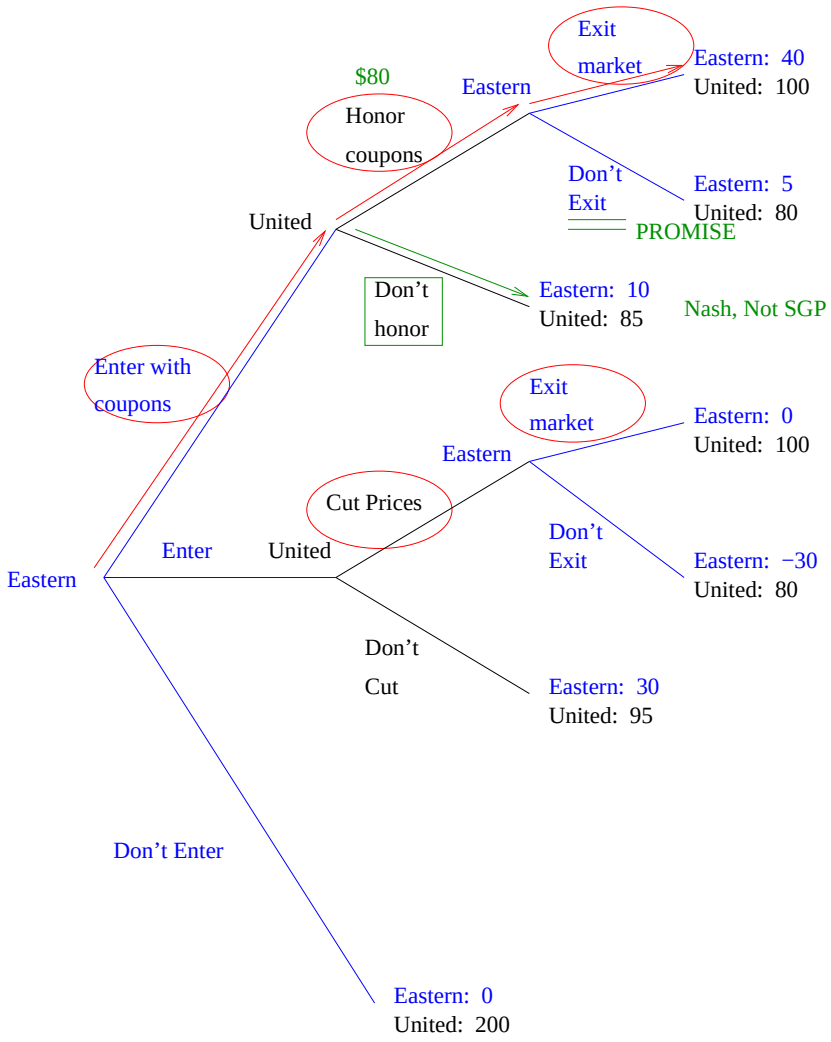

Figure 10: Eastern Airlines.

This is a strange promise, however. Why would Eastern make a promise that leads to a worse outcome for Eastern?

Finally, if Eastern threatens not to exit if United doesn't cut prices, then still it is optimal for Eastern to enter. Therefore, the sub-game perfect equilibrium still results.

c. Yes. This is a bribe: by offering to honor Eastern's coupons, United does Eastern the favor of generating a lot of extra demand for Eastern's domestic route. Eastern then dominates the domestic route. But Eastern cannot break into the overseas route because customers can just use the coupons on United. The market anti-coordinates, but Eastern gets it's preferred (domestic) route.

d. Yes, as noted above, Eastern gets it's preferred route, the domestic route.