The first three questions are from the Risk topic—the first exam will cover up to that point, topics 1 through 3. The rest of this homework is from the Games topic, which will be on the second exam.

1. Jim Corp. has a brilliant invention but no-one's quite sure if it's going to work out. Jim Corp. creates an asset with price $p$ that pays \$1000 if the invention succeeds and \$0 if the invention fails. Say that a DM is a Maxmin Expected Utility maximizer who has a Bernoulli utility function $u(x) = x$ where $x$ is cash and believes that the probability of success is somewhere between $\frac{1}{10}$ and $\frac{1}{2}$. The DM can buy the asset (pay $p$ and receive \$1000 in the success case) or short sell it (receive $p$ and pay \$1000 in the success case).

   For what prices will the DM want to neither sell nor buy this asset? Why is it that this kind of thing can happen with Maxmin Expected Utility? What behavioral phenomenon is Maxmin Expected Utility particularly tailored to rationalize?

2. Consider a loss averse DM with utility function $u(x) = x$ (where $x$ is dollars) and $\lambda \geq 1$. You offer them two possibilities:

   **Option i.** Two sequential 50-50 coin flips, where on each flip heads means you win $j > 1$ dollars and tails means you lose one dollar, and you learn the result of flip 1 before flip 2.

   **Option ii.** Two sequential 50-50 coin flips, where on each flip heads means you win $k > 1$ dollars and tails means you lose one dollar, and you will not learn the result of flip 1 before flip 2.

   **a)** As a function of $\lambda$, how much bigger must $j$ be than $k$ before this DM picks option i over option ii? Explain the relationship you found.

   **b)** Explain how the model of loss aversion is related to Prospect Theory and its motivating evidence from Kahneman & Tversky (1979) that we discussed in class.

3. Say that you're a marketer and you'd like to figure out if you can exploit people's loss aversion and/or reference dependent preferences to sell them more of your company's stuff or increase their engagement with your product. Think of a way in which you might be able to do that, and propose an experiment that an economist could realistically run to explore whether your idea would work. [200-300 words.]

4. Consider a variation on the beauty contest game from class. Each player must simultaneously choose an integer between 0 and 100 (inclusive). The average of the chosen numbers will be calculated; call this average $x$. The player whose number is closest to $x$ will win and earn a positive payoff. If two or more players are equally close to $x$, the winner will be chosen at random among them. Players who do not win earn a payoff of zero.

   a) What are the pure strategy Nash equilibria if there are two players?

   b) What are the pure strategy Nash equilibria if there are three players?

c) Let the number of players be 'large'. Let the level 0 strategy be to choose a number at random. Find the outcome when all players are level $k$ reasoners with $k > 0$.

5. Consider the simultaneous-move game represented by the following matrix:

| Row Player \ Column Player | $L$ | $R$ |
|---|---|---|
| $T$ | $2, 0$ | $1, 3$ |
| $B$ | $1, 1$ | $3, 0$ |

**a)** If the L0 action places an equal probability on each pure strategy, derive actions for L1 through L4 of each player.

**b)** If all players are level $k > 0$ reasoners, does it always pay to think more deeply? That is: do players always do better when they have a higher level of reasoning than they would if they had a lower level of reasoning? If not, show with an example.

**c)** The unique Nash equilibrium in this game is in mixed strategies: Row plays $T$ with probability $\frac{1}{4}$ and $B$ with probability $\frac{3}{4}$, and Column plays $L$ with probability $\frac{2}{3}$ and $R$ with probability $\frac{1}{3}$.

Say that the population was made up of a fraction $\alpha$ of L3 players and a fraction $(1-\alpha)$ of L4 players. Are there any values of $\alpha$ such that both players are better off (on average) than they would have been in the unique Nash equilibrium? If so, which?

6. Consider the simultaneous-move game represented by the following matrix:

| Player 1 \ Player 2 | $L$ | $C$ | $R$ |
|---|---|---|---|
| $T$ | $0, 1$ | $2, 0$ | $1, 3$ |
| $M$ | $0, 2$ | $1, 0$ | $2, 1$ |
| $B$ | $4, 0$ | $3, 3$ | $0, 0$ |

**a)** Find the unique Nash equilibrium in pure strategies.

**b)** Let each player's L0 action be a uniform distribution over his set of pure strategies. Start to derive Lk actions for the two players. After how many levels of reasoning by each player does the level-k process 'stabilize' at the Nash equilibrium?