Notes on Cost Minimization and Liability Rules:

In the following sets of chapters, we have that X represents the injurer while Y represents the victim. X spends x on damage prevention while Y spends y for damage prevention. We look at the costs because society does not want to just minimize the cost of damage; it also wants to minimize the costs incurred by damage prevention. Hence, each individual will keep spending until the very last dollar spent reduces the damage by a dollar. One other thing to note is that the spending of the victim and of the injurer on damage prevention are substitutes. This statement implies that the marginal effect of an additional dollar spent by the victim on damage prevention is lower in instances when the injurer incurs higher damage prevention costs compared to when the injurer does not incur as much of those costs. Another way to say this is that one party is less cautious when the other is more careful.

Now, we need to introduce/reiterate the concept of Cournot-Nash Equilibria. First of all, do not confuse this with Pareto Optimality. They are not the same and one <u>does not</u> imply the other. We will elaborate on this more later but for now, we need to discuss the definition. Again, society wants to create the correct incentive structure through a liability rule system so that both the injurer and the victim choose the correct allocation of inputs into damage reduction. An equilibrium is then reached if we have the following:

An outcome x^e and y^e is a Cournot Nash equilibrium, if given y^e, the x that maximizes X's utility is x^e; and given x^e the y which maximizes Y's utility is y^e.

That is, we have an equilibrium, if given Y's choice, X does not want to change his choice, and given X's choice, Y does not want to change her choice. Again, do not mix this up with Pareto Optimality. As will be shown below, all of our choices can be Pareto Optimal but not all of them are Cournot Nash equilibria. In fact, there are instances when we don't have a Cournot Nash Equilibrium. However, the following examples do and I'll break them down as much as possible.

The first is called the Prisoner's Dilemma, a concept that has had many applications in different fields. The payoffs (or numbers in the cells) represent the number of years that the prisoner will face given the circumstances. Hence, we assume the prisoner wants as low of a number of years in prison as possible (and not care about anything else). In this setup then, the lower the number, the more preferred is the option for the individual. The first number in each cell represents the number of years for R while the second number are those for C. We then can see that if both did not squeal, the cell that both will be in will be (7 , 7).

R / C	squeal	not squeal
squeal	10 , 10	5 , 20
not squeal	20 , 5	7 , 7

Note that these combinations, aside from both squealing, are Pareto Optimal. However, if both squealed, then the two would have attained equilibrium. How do we know this? This is because given that R squealed, C can either choose to squeal with 10 years in prison or not squeal and get 20 years in prison. Of course, C would choose to also squeal. On the other hand, given that C squeals, R will also be better off by squealing so R would squeal. In fact, this is the only equilibrium (verified by following the same structure for the other cells) but as stated earlier, this allocation is not Pareto Optimal.

Now, it is important to discuss the concepts of strict and no liability by the injurer X. These are in the opposite ends of the liability spectrum since strict liability places any damages on X while no liability places all damages on Y. They are appropriate only where one side (the injurer in the case of strict liability or the victim in the case of no liability) can effectively reduce damage. Since strict liability places any and all damage costs on X, Y will minimize her damage prevention costs by not incurring any at all (y = 0). As a result, strict liability is efficient only when the optimal amount of damage prevention by the injured person, Y, is zero. An example would be power plant explosions where the victim can do little to prevent harm and any damage prevention by the victim is not cost effective.

In the case of no liability by the injurer, the victim is again liable for all damages. Hence, X will choose to spend nothing on preventing damage (x = 0) on Y (ignoring ethical and emotional reasoning here) and Y will keep spending on damage prevention until the last dollar spent reduces the cost of damage by a dollar.

Of course, both parties would like to minimize their corresponding costs. Furthermore, there are many cases where efficiency demands that both sides undertake precaution since both sides are implicit to the production of the damage. If one side is found to spend less than the optimal on damage prevention, then that side is considered to be negligent (X is negligent if $x < x^{\Omega}$ and Y is negligent if $y < y^{\Omega}$, where x^{Ω} and y^{Ω} are the optimal amounts of damage prevention).

Notes on Simple Negligence:

As mentioned earlier, X is negligent if $x < x^{\Omega}$. If this is so, X is liable for the damage so

$$C^{X:N} = x + D(x,y) \quad \text{and} \quad C^{Y:N} = y + D(x,y) - D(x,y) = y$$

In words, these equations imply that if Y has chosen y^{Ω}, then X will choose x^{Ω} so that he will not be liable for the damage. He will not spend beyond x^{Ω} because he is not liable when he chooses $x = x^{\Omega}$ and he is not compensated for any additional damage prevention costs he incurs beyond x^{Ω}. As a result, this rule creates incentives for efficient behavior in which

$$x = x^{\Omega} \text{ and } y = y^{\Omega}.$$

Furthermore, x^{Ω} and y^{Ω} are Cournot-Nash Equilibrium. This is because if X chooses x^{Ω}, Y's cost function is

$$C^{Y:N} = y + D(x^{\Omega}, y).$$

Y will then increase y until the last dollar spent on damage prevention by Y reduces damage by a dollar. That amount of y is y^{Ω}.

Notes on Comparative Negligence:

One way to visualize this is by referring to the following table:

Scenarios	x	y	R^X	$C^{X:CN}$	$C^{Y:CN}$
Only X is negligent	$x < x^{\Omega}$	$y \geq y^{\Omega}$	1	$x + D(x,y)$	y
Only Y is negligent	$x \geq x^{\Omega}$	$y < y^{\Omega}$	0	x	$y + D(x,y)$
Both are negligent	$x < x^{\Omega}$	$y < y^{\Omega}$	$\frac{x^{\Omega} - x}{x^{\Omega} - x + y^{\Omega} - y}$	$x + \frac{x^{\Omega} - x}{x^{\Omega} - x + y^{\Omega} - y} D(x,y)$	$y + \frac{y^{\Omega} - y}{x^{\Omega} - x + y^{\Omega} - y} D(x,y)$
Neither X nor Y is negligent	$x \geq x^{\Omega}$	$y \geq y^{\Omega}$	0	x	$y + D(x,y)$

where R^X is the injurer's relative negligence. Note that when both are negligent,

$R^X = \frac{x^\Omega - x}{x^\Omega - x + y^\Omega - y}$. In words, the injurer's relative negligence when both the victim and the injurer are negligent is the portion of the overall amount of negligence coming from the injurer. This follows from the fact that the denominator of this fraction is the sum of the deviations from the optimal amounts of care that both parties should have taken.

An example of a case when both are negligent can be related to speeding. When an accident occurred, we should look at how fast both the victim and the injurer have been going. Let the speed limit of the area where the accident took place be 60 mph. If the victim is going at 70 mph and the injurer is going at 80 mph, we know that the victim has gone 10 mph over the speed limit while the injurer has gone over the speed limit by 20 mph. We calculate the relative negligence of the injurer by the following:

$$R^X = \frac{x^\Omega - x}{x^\Omega - x + y^\Omega - y} = \frac{20}{20 + 10} = \frac{20}{30} = \frac{2}{3}.$$

Hence, the injurer is liable for $\frac{2}{3}$ of the damage. Note that from lecture, we know that x^Ω, y^Ω is a Cournot-Nash Equilibrium.

Notes on Negligence vs. Strict Liability:

Typically, a negligence rule determines the optimal amount of inputs given that an activity takes place but not the optimal amount of the activity. Think of this in terms of driving. With negligence rules, people may want to avoid walking around the streets as a way to prevent damage but there may be too many drivers on the road (who may just be driving carefully). On the other hand, with strict liability, people may not want to drive as much because of the law so that there may be too many pedestrian on the roads. Hence, these are both the situations in which potential injurers and victims minimize their own costs given the laws that are imposed.

Note again the strict liability is implemented when it is unclear whether the injurer should be undertaking the activity in the first place and prevention by the victim is not cost-effective. A negligence rule would achieve the same short-term incentives, but different long-term incentives.

However, when an Act of God (a scenario that is highly unpredictable and is not cost-effective to prepare for) occurs, whatever the liability ruling may be, the same level of prevention would be undertaken by both sides: $x^\Omega = 0 = y^\Omega$. This is because in economic terms, it is not cost-effective for any individuals to incur prevention costs for these situations and so they shouldn't incur any of these costs. In the case of a tree flying on top of a rooftop during a storm, the tree owner is not held liable for the damage.