Adverse Selection Dynamics Class Problem Solutions

Finance 4335, March 3, 2020

The Government Employee Car Krash Organization (also known as "GECKO") does business in Estonia, where automobile liability insurance is not compulsory; i.e., licensed drivers are allowed to (as a matter of their own volition) decide whether or not to purchase such insurance. However, the Estonian insurance commissioner requires that GECKO must offer full coverage and charge the same premium to all of its policyholders. Furthermore, the premium must be set such that the dollar value of GECKO's expected profit from selling insurance is equal to \$0.

GECKO estimates that the accident probabilities for the following five driver types are as follows (for simplicity, assume that there is only one of each driver type):

Driver Type	**Probability of Accident**
Cautious Caroline	5%
Nervous Nora	25%
Average Arvis	30%
Aggressive Anna	35%
Hot Rod Henriks	40%

The dollar value of initial wealth and loss due to an accident for all driver types are \$100,000 and \$40,000 respectively. This implies that if an accident occurs, then the dollar value of uninsured wealth falls to \$60,000. Furthermore, utility $U(W) = \sqrt{W}$ for all driver types. All drivers can pay the same insurance premium (P) which will fully cover accident-related loss.

1. Suppose that GECKO initially sets the premium at P = \$10,800. This premium will enable GECKO to comply with Estonian insurance regulations, so long as all five driver types purchase insurance. Calculate 1) the cross-subsidies that are implied by such a pricing scheme if all five driver types purchase coverage, and 2) expected utilities for all five driver types.

Driver Type	**Probability of Accident**	**Expected Loss**	**Subsidy**	**EU(uninsured)**	**EU(insured)**
Cautious Caroline	5%	\$2,000	-\$8,800	312.66	298.66
Nervous Nora	25%	\$10,000	-\$800	298.41	298.66
Average Arvis	30%	\$12,000	\$1,200	294.84	298.66
Aggressive Anna	35%	\$14,000	\$3,200	291.28	298.66
Hot Rod Henriks	40%	\$16,000	\$5,200	287.72	298.66
	Total Expected Loss	\$54,000			
	Combined Premium	\$10,800			

Figure 1: Cross-Subsidies when all 5 driver types purchase coverage for \$10,800

2. The situation described in part 1 of this problem is not a stable equilibrium, since Cautious Caroline has higher expected utility if she opts out of purchasing coverage for a price of \$10,800. Since the expected loss costs for the remaining four clients now totals \$52,000, the new combined premium must therefore increase from \$10,800 to \$52,000/4 = \$13,000. Calculate 1) the cross-subsidies that are implied by such a pricing scheme if the four remaining driver types purchase coverage, and 2) expected utilities for the four remaining driver types.

3. The situation described in part 2 of this problem is also not a stable equilibrium, since Nervous Nora has higher expected utility if she opts out of purchasing coverage for a price of \$13,000.

Driver Type	Probability of Accident	Expected Loss	Subsidy	EU(uninsured)	EU(insured)
Nervous Nora	25%	$10,000	-$3,000	298.41	294.96
Average Arvis	30%	$12,000	-$1,000	294.84	294.96
Aggressive Anna	35%	$14,000	$1,000	291.28	294.96
Hot Rod Henriks	40%	$16,000	$3,000	287.72	294.96
	Total Expected Loss	$52,000			
	Combined Premium	$13,000			

Figure 2: Cross-Subsidies when the 4 remaining driver types purchase coverage for $13,000

Since the expected loss costs for the remaining three clients total $42,000, the new combined premium must therefore increase from $13,000 to $42,000/3 = $14,000. Calculate 1) the cross-subsidies that are implied by such a pricing scheme if the three remaining driver types purchase coverage, and 2) expected utilities for the three remaining driver types.

Driver Type	Probability of Accident	Expected Loss	Subsidy	EU(uninsured)	EU(insured)
Average Arvis	30%	$12,000	-$2,000	294.84	293.26
Aggressive Anna	35%	$14,000	$0	291.28	293.26
Hot Rod Henriks	40%	$16,000	$2,000	287.72	293.26
	Total Expected Loss	$42,000			
	Combined Premium	$14,000			

Figure 3: Cross-Subsidies when the 3 remaining driver types purchase coverage for $15,000

4. The situation described in part 3 of this problem is also not a stable equilibrium, since Average Arvis has higher expected utility if he opts out of purchasing coverage for a price of $14,000. Since the expected loss costs for the remaining two clients (Aggressive Anna and Hot Rod Henriks) total $30,000, the new combined premium must therefore increase from $14,000 to $30,000/2 = $15,000. Calculate 1) the cross-subsidies that are implied by such a pricing scheme if the two remaining driver types purchase coverage, and 2) expected utilities for the two remaining driver types.

Driver Type	Probability of Accident	Expected Loss	Subsidy	EU(uninsured)	EU(insured)
Aggressive Anna	35%	$14,000	-$1,000	291.28	291.55
Hot Rod Henriks	40%	$16,000	$1,000	287.72	291.55
	Total Expected Loss	$30,000			
	Combined Premium	$15,000			

Figure 4: Cross-Subsidies when the 2 remaining driver types purchase coverage for $15,000

The situation depicted by Figure 4 depicts a stable equilibrium, in the sense that neither client has incentive to defect. Even though Aggressive Anna cross-subsidizes Hot Rod Henriks' premium cost by $1,000, she still prefers "unfair" coverage over no coverage at all.