

ACSC/STAT 3703, Actuarial Models I

WINTER 2025

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Homework Sheet 1

Due: Thursday 23rd January: 14:30

Note: This homework assignment is only valid for WINTER 2025. If you find this homework in a different term, please contact me to find the correct homework sheet.

Basic Questions

1. A customer has utility function $u(x) = 1 - e^{-\frac{x}{10000}}$. The customer's current wealth is \$15,000. The customer's home has the following risk of sustaining fire damage.

Probability	Damage
0.93	0
0.05	\$2,000
0.02	\$9,000

How much would the customer be willing to pay for insurance that would cover this damage?

2. Which of the following risks are insurable? For risks which are not insurable, explain why they are not insurable. If there is not enough information to judge, explain what the insurability depends on.
 - (i) The risk that a computer will be obsolete in 20 years.
 - (ii) The risk that climate change will reduce the value of a house.
 - (iii) The risk that a spaceship travelling to a distant planet in the year 2300 will be destroyed by alien attackers.
 - (iv) The risk that a sports team will lose an important match.
 - (v) The risk that a bottle of milk will go bad.
 - (vi) The risk that an individual will be unsuccessful in a job interview.
3. A homeowner's house is insured at \$330,000. The insurer requires 70% coverage for full insurance. The home sustains \$13,500 damage from fire. The policy has a deductible of \$10,000, which decreases linearly to zero when the total cost of the loss is \$20,000. The house is valued at \$690,000. How much does the insurer reimburse?

4. A worker's compensation insurance policy has a deductible of \$2,000, a policy limit of \$5,000,000 and co-insurance such that the injured party pays 10% of the remaining claim. How much does the insurer pay if the loss is:
- (i) \$1,400
 - (ii) \$2,600
 - (iii) \$5,142,000
 - (iv) \$7,330,000

Standard Questions

5. An insurer charges a loading of 25% on its policies with limit \$1,000,000, and a loading of 28% on its policies with limit \$1,500,000. A reinsurer offers stop-loss reinsurance of \$1,000,000 over \$1,000,000 for a loading of 35%, or stop-loss reinsurance of \$500,000 over \$1,500,000 for a loading of 45%. The second reinsurance policy costs exactly half as much as the first. Both of these reinsurance policies would result in the same premium for a policy with limit \$2,000,000. What would the overall loading of this policy be?
6. Policyholders are assumed to have a utility function $u(x) = \log(x)$, and wealth varies between policyholders following a distribution with survival function $S(w) = \frac{\theta}{\theta + w - 4000}$ for $w > 4000$, for some unknown parameter θ . An insurance company sells an insurance policy which covers a risk which causes a loss of \$4,000 with probability 0.5. The insurer finds that 20% of potential customers would buy the policy for a premium of \$2,500. What premium should they set to maximise expected profits? Justify your answer. [Remember the average payment of \$2,000 per policy needs to be subtracted from the premium to get profit per policy.]
- (i) \$2,106
 - (ii) \$2,352
 - (iii) \$2,603
 - (iv) \$2,913