STOCKHOLMS UNIVERSITET
MATEMATISKA INSTITUTIONEN
Avd. Matematisk statistik

MT5011 – Part TEOR
EXAM
June 1, 2021

Exam in Basic Insurance Mathematics, 7.5 credits

June 1, 2021 – time: 9–17

Examiner: Mathias Lindholm, `lindholm@math.su.se`

Additional tools and material: Anything you like as long as you do not discuss the exam with anyone!

Return of the exam: Online.

Each correctly solved problem is worth 10 points. All arguments must be clear and easy to follow.

The grades A–E are set according to the following minimum point levels:

Grade	A	B	C	D	E
Points	43	38	33	28	23

Additional information

- IT IS ONLY POSSIBLE TO REPORT YOUR RESULTS IF YOU ARE PROPERLY REGISTERED FOR THE EXAM!!
- If something is unclear or if you experience problems during the exam, please notify me as soon as possible by sending an e-mail to `lindholm@math.su.se`
- To ask questions during the exam you send an e-mail to `lindholm@math.su.se` with the subject "Exam MT5011" together with a Zoom meeting ID.
- I will at least check my e-mail at 10.00, 12.00, 14.00, and 16.00, and will get back to you as soon as I can.

- The exam is supposed to be as close as possible to an ordinary campus exam and you are **not** asked to write thesis type answers.
- **Important:** If I need to get in touch with you during the exam I will use the news forum on the course home page, so please check this regularly.

Problem 0

The following text **must** be written on a separate sheet and handed in together with the solutions:

"I, the author of this document, hereby guarantee that I have produced these solutions to this home exam without the assistance of any other person (except the examiner). This means that I have for example not discussed the solutions or the home exam with any other person (except the examiner)."

Problem 1

Assume that the time to an event T is defined by the following survival function:

$$S(t) := \exp\{-(t/\lambda)^k\}.$$

a) Calculate the hazard rate.

b) Assume $k = 2$ and calculate the MLE of λ based on 100 perfect observation times summarised as

$$\sum_{i=1}^{100} t_i = 416.75, \text{ and } \sum_{i=1}^{100} t_i^2 = 2091.79.$$

c) What would happen with your estimate of λ if right-censoring is present, but you neglect this?

Problem 2

Consider the following incremental claims triangle amounts:

	1	2	3
1	100	27	5
2	173	51	
3	206		

a) Calculate the expected future incremental claim payments using Mack's chain-ladder model.

b) Calculate the expected (undiscounted) cash flow.

c) Calculate an estimate of the standard deviation of $I_{3,2}$ given the information known up until the end of accident year 3. State clearly the assumptions that you make.

Problem 3

Consider an insurance company with n insured that have bought insurance of two types. Assume that the insured only can have at most one claim of each type per year, where all claims are assumed to be independent across insured as well as within an insured. Further assume that all claims are i.i.d. within the type of insurance.

a) Calculate the expected cost for all insured during next year.

a) Calculate the standard deviation of the cost for all insured during next year.

Problem 4

Consider an annuity compensation for income loss due to a disability caused by an accident which pays 1 unit each year given that the individual is alive at its birthday, but no longer than the year of retirement occurring at the age 67. If an individual today has just turned 65, calculate

a) the probability of receiving no further payments,

b) the probability of receiving the maximum remaining amount,

c) the standard deviation of the amount for the last possible payment year.

Use the following life table

x	$1\ 000q_x$
64	4.235
65	6.145
66	6.523
67	6.856
68	7.012

Problem 5

Assume that the total premium is 1000 for a portfolio with 800 identical contracts.

a) If the total safety loading is 215, calculate the individual fair premium and safety loading.

b) If the safety loading is calculated using the standard deviation principle with an individual variance of 52, determine if the contracts are uncorrelated or not.

Good luck!