



## Exercise 9

3. Dezember 2018

Abgabe: 10. Dezember 2018, 12:00:00 Uhr

Briefly discuss your findings. Results without an explanation will not be assessed!

The following problem contains questions about topics presented in the lecture. Although a submission is not required, answering the questions will be a good start for reviewing the lecture's topics for the exam!

### Problem 9.1: Questions for review

#### Chapter 1 – Fundamentals of Simulation Programs

1. **[Bonus]** Why should the *long int* data type be used for implementing the simulation time! +1 Points
2. **[Bonus]** Give an example for a product-oriented and a machine-oriented simulation! +2 Points

#### Chapter 2 – Fundamentals of Statistics I

1. **[Bonus]** How is the mean of a continuous random variable calculated? +1 Points
2. **[Bonus]** How is the mean of a discrete random variable calculated? +1 Points
3. **[Bonus]** How is the sample mean of a sample set calculated? +1 Points
4. **[Bonus]** What is the discrete convolution? Give the formula and explain what it is used for! +2 Points
5. **[Bonus]** How is the distribution function of the minimum of two random variables calculated? +1 Points
6. **[Bonus]** What are histograms? Give an example for their usage! +2 Points
7. **[Bonus]** What are time-weighting counters? Give an example for their usage! +2 Points

### Chapter 3 – Distributions I

1. **[Bonus]** Give the distribution function, the probability density function, the mean, the standard deviation, and the coefficient of variation for the exponential distribution! What is the mean of the Erlang-k distribution? +3 Points
2. **[Bonus]** Give the distribution and the mean for the Bernoulli, binomial, and geometric distribution! +3 Points
3. **[Bonus]** Exponential random variables model random arrivals. What does that mean? Give an example! +2 Points

### Chapter 4 – Sampling Theory

1. **[Bonus]** Explain the meaning of a confidence interval! +2 Points
2. **[Bonus]** What is prerequisite that Student-t confidence intervals are exact? +1 Points
3. **[Bonus]** What are Pivot Tables used for? +2 Points

### Chapter 5 – Fundamentals of Statistics II

1. **[Bonus]** Give the formula for the sample covariance and the sample autocorrelation! +2 Points

### Chapter 6 – Statistical Analysis of Simulation Data

1. **[Bonus]** Why should the transient phase of a non-terminating simulation not be part of the statistical analysis? +2 Points
2. **[Bonus]** Name two methods for the calculation of confidence intervals in case of correlated simulation output! +1 Points

### Chapter 7 – Stochastic Processes

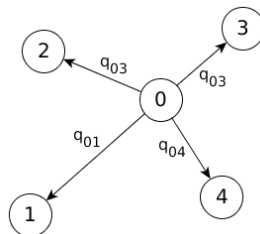
1. **[Bonus]** Under which condition is the mean recurrence time smaller / larger than the mean inter-arrival time? +2 Points

## Chapter 8 – Discrete-Time Markov Chains

1. **[Bonus]** How is the probability transition matrix derived using the forward algorithm? Give the algorithm! +2 Points
2. **[Bonus]** What is the  $k$ -transition probability? +1 Points
3. **[Bonus]** How can the stationary state distribution be calculated? Describe two approaches! Which is faster for high accuracy? +2 Points
4. **[Bonus]** Give an example transition matrix for a periodic markov chain! +1 Points
5. **[Bonus]** Prove that the sojourn time distribution is  $P(k \text{ steps}) = p_{jj}^{k-1} \cdot (1 - p_{jj})!$  +3 Points

## Chapter 9 – Continuous-Time Markov Chains

1. **[Bonus]** What does *PASTA* stand for in this context? +2 Points
2. **[Bonus]** Describe the purpose of the Kaufman & Roberts formula! +1 Points
3. **[Bonus]** What's the probability of the continuous-time markov chain to transit from state 0 to state 1? +2 Points



4. **[Bonus]** A birth-death process with states  $0, \dots, n$  and upwards/downwards transition rates  $\lambda_0, \dots, \lambda_{n-1}$  and  $\mu_0, \dots, \mu_n$  is given. Specify these rates for the following systems when arrival rates are  $\lambda$  and service rates for a single service are  $\mu$ !
  - $M/M/n - 0$
  - $M/M/1 - K$
  - $M/M/s - K$+3 Points

## Chapter 10 – Distributions II

1. **[Bonus]** Name three distribution functions for non-negative random variables with arbitrary positive mean and coefficient of variation!

+5 Points

Total: 

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55 Points