1. You are required to develop an Excel model to analyse repairable systems according to the NHPP distribution. You are provided with three podcasts guiding you through the model development process. The same examples as in chapter 3.8 in your notes are used during the podcasts. The podcasts also illustrate the use of the functions in your notes, so it will be useful to have your notes at hand (especially for the confidence interval calculations).

- **Note: You will be allowed to use your developed model during test week (A1). The onus is therefore upon you to ensure you have a working model. If you don't, you will have to develop it from scratch during the exam.**

2. Refer to chapter 3.8 in your notes and use your model to answer the questions. Ensure your model produces the correct answers.

3. The inter-arrival times of failure events for a motor pump system are given as:

452, 385, 220, 235, 175, 142, 102, 134, 118, 87, 62, 55, 53, 42, 37, 25, 38, 22, 30, 30

The NHPP parameters are given as: alpha_0 = −7.0097; alpha_1 = 0.0014; lambda = 1.14 × 10^(−7), delta = 2.41636.

(a) Give the functions for the log-linear and power law NHPP.

- Ans: rho_1(t) = exp(−7.0097 + 0.0014t); rho_2(t) = 1.14 × 10^(−7) × 2.41636t^(2.41636−1).

(b) Use the log-linear and power law NHPP and calculate the reliability of the motor pump system set at the 100th time period.

- Ans: R(rho_1) = 90.761%; R(rho_2) = 99.22742%.

(c) Calculate the MTBF over the total observed period by using the log-linear and power law NHPP.

- Ans: MTBF(rho_1) = 127.921 time periods; MTBF(rho_1) = 139.42 time periods.

(d) The motor and pump set is put into operation after the last failure. When is the next failure expected according to the log-linear and power law NHPP?

- Ans: mu_21 = 65.42 time periods (log-linear); mu_21 = 56.76 time periods (power law)

(e) Assume the cost of minimal repair is R850 and the cost of a complete system replacement is R20000. Use the log-linear and power law NHPP to specify the optimal system replacement. Express your answer in both time and number of minimal repairs. Watch the podcast about conducting long term cost optimisation of repairable systems in Excel.

- Ans: For the log-linear NHPP the optimal time is, T* = 2063 time periods with a cost of, C_R = R13,79 per time periods. The optimal number of repairs are, N* = 13, with a cost of R14,32 per time periods.
- For the power law NHPP the optimal time is, T* = 2348 time periods with a cost of, C_R = R13,92 per time periods. The optimal number of repairs are, N* = 16, with a cost of R13,92 per time periods.

Submission status

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