Authors' response to referee reports:

Associate Editor Report

General comments

1. The constant λ appearing as the intensity of HPPs has been replaced by ν to avoid confusion with intensity *functions* $\lambda(\cdot)$.

   Truncation has been replaced by the more correct *censoring*, (although the word *truncation* is commonly used in repairable systems literature).

2. The definition of TRP in Section 3 has been revised to include the points (a)-(c) suggested by the AE.

3. The *inhomogeneous Weibull process* considered in (old) Section 7.2 was originally included because it generalized the model by Follmann and Goldberg (1988) by including a time trend. We agree, however, that the model as it appears in our old paper seems very unnatural and we therefore decided to take it out.

   We think, however, that the *inhomogeneous gamma process* of (old) Section 7.1 should be kept in the paper. Indeed, for a single system this model corresponds exactly to the general form of Berman's process, and our model therefore shows how Berman's model can be generalized to the case of several processes with heterogeneity. Moreover, there is even an explicit expression for the likelihood of the HTRP. In turn, for $\lambda(\cdot) = \lambda_{pl}(\cdot)$ the model generalizes Black and Rigdon's (1996) modulated power law process to several processes with heterogeneity.

   Since (old) Section 7 would otherwise be very short, we have moved the *inhomogeneous gamma process* to Sections 5.1 (and 6.1), where it appears in the form of an Example.

4. The relevance of using asymptotic theory is now discussed in the section on parametric inference. It is argued there that for cases where the asymptotics is not likely to hold, one could use bootstrapping. Indeed, it is indicated why bootstrapping is particularly simple in TRP models.

5. **(a)** The TTT-plot is basically equivalent to a hazard plot.

   (b) This is explained in (new) Section 6. The censorings are taken care of in the process $R(t)$ which is used to define the TTT-statistic.

   (c) All our models are parametric, where the parameters also are present in the parts of the likelihood corresponding to censorings.

   (d) As explained in (new) Section 6, the Anderson-Darling statistic is computed from the scaled TTT-statistic, which by definition does not involve censorings. The censoring is taken care of in the $R(t)$ defining the TTT-statistic (see point (b) above).

6. We agree that the Proschan airconditioner data are overanalyzed in the literature, and should be avoided. On the other hand, we feel that Proschan's case study is extremely suitable for illustrating our model and our estimation approach. Moreover, using data for all the planes, our analysis is completely consistent with the ones of Proschan and the subsequent one of Follmann & Goldberg (Technometrics 1988). In addition our analysis may throw new light on the case by introducing the possibility of a time trend.

   In order to increase the readability of the example, we have expanded it somewhat, including some background discussion on Proschan's (1963) contribution.

   Finally we quote from Referee 2 that "a strength is that some standard datasets are successfully analysed...."

7. The compressor data of Erlingsen are now given explicitly in Table 2. (In fact we have also changed the data slightly by counting failures on the same day as *single* failures).

Specific comments

1. HPP has been replaced by NHPP

2. The stopping time τ is now explained more precisely (Section 2). Moreover, a general discussion of censoring is included and the notions of failure censoring and time censoring are introduced.

3. We write instead "The inhomogeneous gamma process (Berman 1981) corresponds to F being a gamma-distribution in the definition of the TRP."

4. The connection between TRP and accelerated failure time models has now been described more in detail in Section 3. Some of the discussion on accelerated failure time models in the (old) final section has been moved to Section 3. In the new discussion there is no mentioning of covariates.

5. The X_i and X_{ij} in (old) Sections 2 and 4.2 are never used and are therefore removed. The X_{ij} in (old) Equation (14) are replaced by $\hat{R}_{ij}$.

6. The models have been put into a table, and some relevant references are given in this table.

7. See General comments no. 1

8. It may be possible to avoid the partition of θ into the three parameters $\theta_F, \theta_\lambda, \theta_H$. However, we feel that it would then be more difficult to describe the restrictions for the submodels, which then would be given by certain subsets of Θ.

As regards boundary points, in our examples with gamma distributions used for heterogeneity, the case of no heterogeneity is indeed a boundary point. This has now been discussed in the section on "Parametric Inference in the HTRP model".

9. See General comments No. 4.
10. See General comment No. 5(a). It should also be noted that the censoring mechanisms are reflected also in the bootstrap procedures, which indicates the "correctness" of the bootstrap results.
11. See General comments no. 3
12. See General comments no. 1 and Specific comments no. 2
13. It is of course difficult to assess closeness simply by looking at plots. This is why we also suggest computing statistics like the Anderson-Darling statistic, and compare those to critical values found by bootstrapping. According to the assumptions on the censoring, and the construction of the plots, the TTT plots take care of the censoring in the sense that censoring should not lead to unwanted biases in the plots.
14. This example has been completely revised and rewritten.
15. See Specific comment no. 4 above.

Authors' response to referee reports:

Referee I

1. *It* is incerted.
2. Proper reference is given.
3. Stopping time has been defined by referring to Andersen et al. (1993), and an additional discussion is now given.
4. The X_i and X_{ij} in (old) Sections 2 and 4.2 are never used and are therefore removed.
5. A table as suggested has been included.
6. We have dropped the old Figure 2, as suggested. We have also added labels $F, H, \lambda(\cdot)$ to the arrows starting at the HPP box in (new) Figure 2. We think this is enough for illustrating the three directions of the figure.
7. A more thorough discussion of asymptotics is now included in Section 5 of the paper, in particular addressing the points of the referee.
8. The name REIDAR was chosen because it is a common boys' name in the country of the authors. (REDAR would not have this nice interpretation).
9. The conditional intensity has been changed from $\lambda(\cdot|\cdot)$ to $\phi(\cdot|\cdot)$ (and corresponding capitals for integrated intensity).
10. The definition of residuals by (12) of the old paper, was not correct (as indicated by Referee 1). The correct definition is used in Section 6 of the revised paper. Note that the correct definition was fortunately used in the plots and computations of the original paper, so these needed no changes.
11. This has been done.
12. A reference to a result in Lehmann (1999) is included. This is a result on the asymptotic distribution of the correlation coefficient of a set of i.i.d. observations.
13. This has been addressed in Section 6 and in connection with the bootstrapping in Example 7.3.
14. The justification is given in subsection 6.1. in (new) Section 6.
15. The example where this occured has been removed from the paper.
16. This has been taken care of.
17. This is included in (new) Section 5.

18. The examples differ in the results so we suggest to include both. For example, the tractor engine example gives a case where the maximum likelihood estimator of the heterogeneity parameter is on the boundary of the parameter space ($\delta = 0$).

19. These parts have been kept.

20. Discussion of accelerated time models has been removed from the section on concluding remarks and now appears in Section 3. Some parts of (old) concluding remarks hav been removed as we found them to be rather irrelevant.

21. The use of Figure 1 in the explanation is now made more clear.

22. Kvaløy and Lindqvist (1998) is now referenced in Section 6. We think Brémaud is correct.

Authors' response to referee reports:

Referee II

Calabria, R. and Pulcini, G. (1999) is referenced in the new version.

Engelhardt, M. and Bain, L. J. (1987) is included in the new version. We think this reference is important, so we are thankful for the hint.

Empirical Bayes: A sentence has been added in Section 4 in connection with the introduction of heterogeneity.

page 2, line 9 Corrected

page 2, line 14 *involve* has been replaced by *include*

page 2, line 23 Corrected

page 3, section 2, line 2 "Fully satisfactory" has been kept since it is part of the cited definition of Ascher and Feingold.

Top of page 4, ROCOF In Section 2 we have added the following note which implies that we look at ordely processes only, "We assume throughout that simultaneous failures are not possible, so that the jumps of the process $\{N(t)\}$ are all equal to 1."

page 10, line 4 Corrected

page 11, line 10 from bottom Corrected

page 14 Corrected

page 18-19 The "bimodal exponential" model is no longer considered.

page 20, line 8 + line 11 from bottom Corrected

page 21, line 10 + line 11 Corrected

Final comments We have included a paragraph at the end of Section 6 about alternative plots which could be made.

As regards the purpose of the model-fitting, we agree that there is no extensive discussion of this. In some sense this is beyond the scope of the work, since in practice it will depend on the situation at hand. Some considerations on the TRP framework are given in the Concluding Remarks.

Authors' response to referee reports:

Editor's comments

The comments are taken care of (as far as they still apply to the revised manuscript).