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Exponentiated Weibull distribution approach based inflection S-shaped software reliability growth model

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KEYWORDS

Weibull distribution;
Software reliability growth model;
Reliability approximation;
Coefficient of multiple determinations;
Relative prediction error;
Mean square fitting error

Abstract The aim of this paper was to estimate the number of defects in software and remove them successfully. This paper incorporates Weibull distribution approach along with inflection S-shaped Software Reliability Growth Models (SRGM). In this combination two parameter Weibull distribution methodology is used. Relative Prediction Error (RPE) is calculated to predict the validity criterion of the developed model. Experimental results on actual data from five data sets are compared with two other existing models, which expose that the proposed software reliability growth model predicts better estimation to remove the defects. This paper presents best software reliability growth model with including feature of both Weibull distribution and inflection S-shaped SRGM to estimate the defects of software system, and provide help to researchers and software industries to develop highly reliable software products.

1. Introduction

The Software reliability model specifies the general form of the dependence of the failure process on the factors mentioned. Most software reliability models (SRM) are based on using a stable programme in a stable way. This means that neither the code nor the operational profile is changing. If the programme and environment do change, they often do so and are usually handled in a piecewise fashion. Thus the models focus mainly on fault removal. If either fault introduction, fault removal or operational profile changes are occurring,

Abbreviations: DS, data set; SPSS, Statistical Package for Social Sciences; MSE, Mean Square Fitting Error; R^2, Coefficient of Multiple Determination; RPE, Relative Prediction Error; SS, sum of squares; GFC, Goodness of Fit Criterion; PVC, Predictive Validity Criterion

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Table 1 Parameter estimation for 5 data sets according to distinct SRGMs.

Data set	Model discretion	Parameter estimation		
		a	*b*	*r*
DS-I	Yamada delay S-shaped SRGM	103.984	0.265	–
	Ohba inflection S-shaped SRGM	110.829	0.172	0.837
	Developed SRGM	116.733	0.273	0.169
DS-II	Yamada delay S-shaped SRGM	127.399	0.242	–
	Ohba inflection S-shaped SRGM	124.445	0.254	0.209
	Developed SRGM	129.708	0.332	0.110
DS-III	Yamada delay S-shaped SRGM	76.695	0.288	–
	Ohba inflection S-shaped SRGM	62.630	0.568	0.058
	Developed SRGM	63.240	0.595	0.051
DS-IV	Yamada delay S-shaped SRGM	47.229	0.207	–
	Ohba inflection S-shaped SRGM	43.363	0.279	0.134
	Developed SRGM	44.575	0.354	0.076
DS-V	Yamada delay S-shaped SRGM	1689.370	0.090	–
	Ohba inflection S-shaped SRGM	1331.053	0.201	0.047
	Developed SRGM	1485.927	0.222	0.036

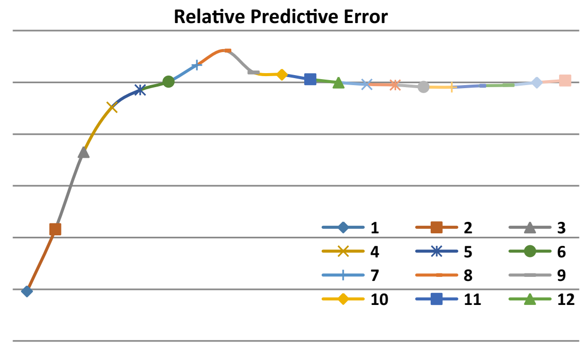

Figure 1b RPE of Yamada model on DS-I.

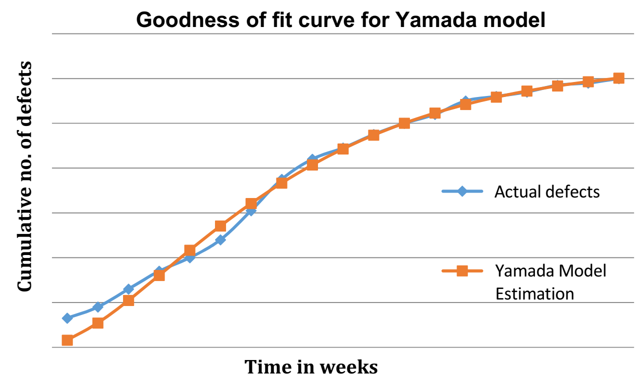

Figure 2a Goodness of fit of Yamada model on DS-II.

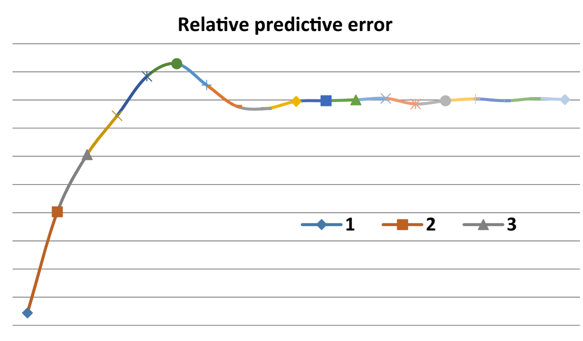

Figure 2b RPE of Yamada model on DS-II.

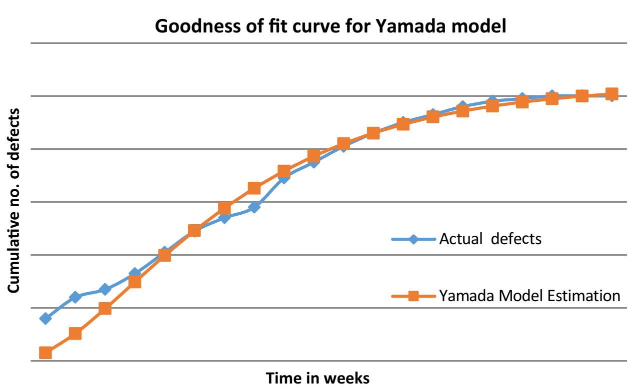

Figure 1a Goodness of fit of Yamada model on DS-I.

the failure intensity will be constant, and the model should simplify to accommodate this fact. In general terms, a good model enhances communication on a project and provides a common framework of understanding for the software development process developing a software reliability model that is useful in practice involves substantial theoretical work, tool building and the accumulation of a body of loss from practical experience. Research on software reliability engineering has been conducted during the past three decades and numerous statistical models have been proposed for estimating software reliability [1]. Most existing models for predicting software reliability are based purely on the observation of software product failures where they require a considerable amount of failure data to obtain an accurate reliability prediction. To estimate the failure and faults in software products Software Reliability Growth Models (SRGM) have been developed to measuring the growth of reliability of software which is being improved. The component based software system reliability increases as the component reliability increases [2]. Software reliability modelling and estimation are a measure concern in the software development process particularly during the software testing phase as unreliable software can cause a failure in the computer system that can be hazardous [3]. The software error detection phenomenon in software testing in model by a Nonhomogeneous Poisson Process (NHPP) is presented.