Fit Data Selection for Software Effort Estimation Models

Koji Toda
NARA Institute of Science and Technology
Kansai Science City, 630-0192 Japan
koji-to@is.naist.jp

Akito Monden
NARA Institute of Science and Technology
Kansai Science City, 630-0192 Japan
akito-m@is.naist.jp

Ken-ichi Matsumoto
NARA Institute of Science and Technology
Kansai Science City, 630-0192 Japan
matumoto@is.naist.jp

ABSTRACT

To construct a better multivariate regression model for software effort estimation, this paper proposes a method to select projects as a fit data from a given project data set based on estimation target's features. While regression models were often constructed from all available project data, this paper showed the necessity of fit data selection, and showed that the proposed method is one of the effective and systematic means to do the selection.

Categories and Subject Descriptors

D.2.9 [**Software Engineering**]: Management – *Cost estimation*, K.6.1 [**Management of Computing and Information**]: Project and People Management – *Strategic information system planning*

General Terms

Management, measurement, economics

Keywords

Effort estimation, Multivariate regression.

1. BACKGROUND

Multivariate regression modeling is a simple but widely used method for software effort estimation[1]. It is because various tools for model construction are available, various variable selection methods such as forward-backward stepwise selection are available, and it also gives reasonable estimation performance.

However, few researches have been made on how to prepare a proper fit dataset for the model construction. Indeed, regression model's estimation performance greatly depends on the fit data. Generally speaking, to construct a better model, fit data should contain similar projects whose development environments, processes or application domains are the same.

2. PROPOSED METHOD

We propose a systematic method to select fit data for regression models. Our basic idea is to select candidates of fit data sets as many as possible each having at least one similar feature with the target project, build regression models using each candidate, and pickup one model (and its fit data candidate) having the best fit to the data. The procedure is shown in Figure 1.

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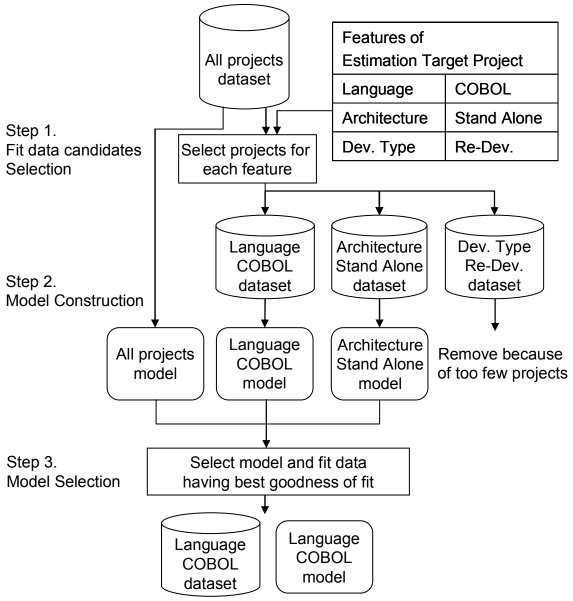

All projects dataset
Step 1.
Fit data candidates Selection
Select projects for each feature
Language COBOL dataset
Architecture Stand Alone dataset
Dev. Type Re-Dev. dataset
Step 2.
Model Construction
All projects model
Language COBOL model
Architecture Stand Alone model
Remove because of too few projects
Step 3.
Model Selection
Select model and fit data having best goodness of fit
Language COBOL dataset
Language COBOL model

Features of Estimation Target Project	
Language	COBOL
Architecture	Stand Alone
Dev. Type	Re-Dev.

Figure 1. Procedure of fit data selection.

[STEP 1] Candidates of fit data sets are selected from a given project data set (containing all past projects). Each candidate contains projects that have one of features of the target project. If the target project has three features (COBOL, Stand Alone and Redevelopment), each fit data candidate contains COBOL projects, Stand Alone projects and Re-development projects. If the size of a candidate (i.e. the number projects involved) is smaller than the minimum fit data size, we remove this candidate from the candidate set. For example, if the minimum fit data size is 10 projects and "Re-Development candidate" contains 7 projects, this candidate is ignored because of too few projects. In addition to the resultant candidates, we also add a dataset containing all past projects (full set) to the candidates. We do this because selection sometimes causes negative effect to model construction.

[STEP 2] Construct regression models using each fit data candidate and calculate the goodness of fit (e.g., residual mean square or adjusted R-square) for each model.

[STEP 3] Select the best model and its fit data candidate based on the goodness of fit. If "COBOL language model" was the best of three candidates, this model and its fit data candidate is selected.

Table 1. Result of experiment.

	Conventional method	The proposed method with RMS	The proposed method with adj.R^2
MdMRE	0.552	0.383	0.507
Pred(25)	24.6	36.3	30.9

These steps are simplified ones where all project features are given as categorical variables. However, project data sets usually contain quantitative variables (e.g. Function Points and Project Elapsed Time), therefore, we translate the quantitative variables into categorical ones by partitioning each quantitative variable by a given threshold in the fit data candidate selection step.

3. EXPERIMENT

We evaluated the proposed method using a subset of the ISBSG dataset collected by International Software Benchmarking Standard Group (ISBSG)[2]. The data subset we used contains 109 projects and 10 variables. When building regression models, we used the "Summary Work Effort" as an objective variable and we used nine predictor variables, Function Points, Count Approach, Summary Work Effort, Effort Plan, Effort Specify, Development Type, Architecture, Primary Programming Language, Recording Method and Resource Level. Details of these variables are shown in [3]. All these predictor variables can be measured by the design phase. In the experiment, we decided the minimum fit data size to be 10. As the goodness of fit, we tested two criteria: (1) residual mean squared (RMS) and (2) adjusted R-squared (adj.R^2). We used the stepwise multivariate regression analysis as a modeling technique. We spitted the initial dataset into fit and test randomly each having the same size. We repeated this operation 10 times.

The result is shown in Table 1. "Conventional" means that a regression model was built using all available projects (i.e. without fit data selection.) The proposed methods showed better accuracy than the conventional in both criteria. In the proposed method, using RMS as criteria was better than using adj.R^2.

4. SUMMARY

This paper proposed a method to select projects as a fit data from a given project data set based on estimation target's features. The main advantage of the proposed method is that it can be systematically (automatically) used without detailed knowledge about the given project dataset.

5. References

[1] Boehm, B.W. 1981. Software Engineering Economics. Prentice Hall.

[2] International Software Benchmarking Standards Group. 2004. ISBSG Estimating Benchmarking and Research Suite Release 9. International Software Benchmarking Standards Group.

[3] International Software Benchmarking Standards Group. 2000. The Benchmark Release 6. International Software Benchmarking Standards Group.

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