Estimate of the Functional Size in the Requirements Elicitation

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ABSTRACT

Early measurement of software size allows to estimate costs and effort as well as to plan the development schedule. In previous reports, an approach which applies the Function Points Analysis to the derivative Scenarios of the Language Extended Lexicon was presented. In the process of the validation of that proposal, statistical techniques were applied on a subset of the obtained data from the measurement of several cases of study. In this article, a linear regression analysis which allowed establishing an estimate model of the scenarios functional size and the verification of the validity of that model is presented. The results are encouraging as for the feasibility of the model and its possible subsequent refinements.

Keywords: Scenarios, functional size, regression analysis.

1. INTRODUCTION

The management of the development projects or software maintenance activities has a fundamental importance at the organizations economical level [1]. An essential issue is the appropriate estimate of the costs of software development. This has motivated investigation efforts guided to improve the comprehension of the software development process as well as to build and evaluate tools for the estimate of the software costs [2]. To estimate the factors related with a project (effort, staff, schedule, cost, etc.) it is required to know or to estimate its size to evaluate the possible solutions, to compare alternatives and to calculate costs before deciding for a certain approach [1]. CMM V1.1 identifies size as a crucial aspect for the management of the project [3].

A well-known technique to measure the size of the software, the source Lines of Code (LOC), requires having the code, which represents a restriction to make early estimates. The Function Points Analysis (FPA) provides an alternative approach because it allows estimating the size of the software relying on the requirements [4]. The quantity of LOC can be estimated from the size in Function Points (FP) [5].

In [6] and [7] the FP measurement of products of the Elicitation process was introduced, measuring the FP of the scenarios produced with the approach of the Language Extended Lexicon and Scenarios (L&S) [8].

The main contribution of this measurement is to estimate the size of the system to be developed before obtaining the requirements.

The application of the approach allows measuring the *functional size*, which can be used in other estimates that depend on the size. However, can the estimate of the FP be anticipated even more? Is it possible to estimate the FP of the scenarios before completing the established measurement process? One of the objectives of this investigation is to study the feasibility of establishing an estimating model of the scenarios *functional size* without executing the whole process of FP measurement. If this alternative would be possible one could avoid the cost of carrying out the complete process.

From the FP measurement of a group of cases, a dataset was generated and a subset was analyzed statistically. The linear regression analysis on the data allowed describing an estimate model of the size of the system in FP. The dependability of the model was evaluated by means of statistical tests (correlation and determination coefficients, analysis of variance and hypothesis test) with satisfactory results. The linear model represents a first approach to the problem, opening the way to the possibility of other adjustments, for example, a non-linear model may be found to be more appropriate.

The rest of the article is organized in the following way: in section 2 the related proposals are presented, in section 3 the measurement of functionality of the scenarios applying an approach based on the FPA is presented, in section 4 the estimate model is developed based on the statistical analysis of the data of FP measurement, and finally, in section 5 the conclusions and future investigations are described.

2. RELATED PROPOSALS

The related works estimate the size of software artifacts starting from the measurement of previously built artifacts, especially those that try to measure the FP as soon as possible and to convert them to another metric of size of artifacts produced later on, such as the case of the LOC [9].

COCOMO II is a model to estimate costs and chronograms of development projects that uses the size as entrance in its phase of Initial Design. To estimate the size, it determines the FP and then transforms them into LOC by means of equivalencies tables according to the language to use in the coding stage [5].

The FP has also been used as an input to the estimate methods by analogy of the project effort [10]. On the other hand, most of the models of costs (COCOMO II, SLIM, Checkpoint, etc.) use techniques based on regression due to their simplicity and wide acceptance [11].

In our case we investigate the possibility to estimate the FP which corresponds to an artifact produced by the Requirements Elicitation process.

3. MEASUREMENT OF THE SCENARIOS FUNCTIONALITY

Language Extended Lexicon and Scenarios

L&S constitutes an approach of the process of Requirements Elicitation of a software system. The Language Extended Lexicon (LEL) and the Scenarios use descriptions in natural language, which facilitates the validation with the user.

The purpose of the LEL is to know the semantics of the vocabulary of the application, postponing the understanding of the problem. The objective is to register words or sentences that are peculiar for the domain. Each entry in the LEL is composed of *Notion* and *Impact* [12].

The scenarios are used to understand the application and their functionality: each scenario describes a specific situation of the application centering the attention in its behavior. The scenarios are derived from the LEL applying specific heuristics. A scenario is composed of: *Name*, *Objective*, *Context*, *Resources*, *Actors*, *Episodes*, *Exceptions*, and *Restrictions*. *Actors* and *Resources* consist of an enumeration. *Title*, *Objective*, *Context* and *Exceptions* represent declarative sentences. The *Episodes* are sentences expressed in simple language that describe the behavior operationally [8].

Below we give an example of a scenario of the Reception of the Hotel [14] case, using the BMW [13] format:

Cancel a reservation[1]

- Goal
  - Cancel a *reservation request* of a *passenger*.
- Context
  - It is carried out in the *Reception* of the Hotel. There is a *reservation request* for a *passenger*.
- Resources
  - *form for reservations*
  - *form for occupation of rooms*
  - telephone
  - fax
  - e-mail
- Actors
  - *receptionist*
  - *travel agency*
  - another Hotel
  - *passenger*
- Episodes
  - **if** the *receptionist* receives a request to cancel a *reservation request* or the *passenger* does not appear in the period between 12 hours of the date indicated in the *reservation request* and 6 hours of the next day **then** the *receptionist* eliminates the *reservation request* of the *form for reservations.*
  - The *receptionist* updates the *availability of rooms* in the *form for occupation of rooms*.
  - **exception:** The telephone, the fax or the e-mail doesn't work.

[1] Please note that this example was written in Spanish and was freely translated to English.

Function Points Analysis

The FPA measures the size of the software quantifying the functionality provided to the user relying only on the logical design and the functional specifications [15].

The MarkII FPA method developed by Symons measures the *functional size* of any software application that can be described in terms of *logical transactions*. The *functional size* of an application is the addition of the *functional sizes* of each *logical transaction* [4].

Considering the foundations of the MarkII method [16], we established an approach of the scenarios (generated in the frame of L&S) FP measurement and a set of rules that support the measuring process [6], [17]. In the sequence of execution of measurement of the scenarios *functional size* [17] the stages are:

1. *Determine the viewpoint and purpose of the count*. The purpose (to use the FP to estimate cost, effort and schedule) and the user's point of view are established.
2. *Define the boundary of the count*. It includes all the scenarios that represent the functionality of the system from the user's vision. The scenarios are break down in all their *episodes* obtaining the group of *total episodes*.
3. *Identify the episodes*. Each *episode* of the group of *total episodes* is evaluated according to the criteria established by the rules; in this way, the *episodes* that are considered relevant for the measurement of FP are detected. These *episodes* form the group of *net episodes*; the remaining form the group of *discarded episodes*. The FP are calculated considering the *net episodes*.
4. *Break down the episodes*. For each *net episode* the items that contribute to the *functional size* are determined, this requires to recognize the Input-Process-Output components of the *episode*. In the Input and Output components the *Data Element Types (DET)* are identified as well as in the

Process component the *referenced resources* [6], [17].

5. *Count the input DET, the referenced resources and the output DET*. For each *net episode* the contributions of the items identified in each component are registered according to the established rules. The sum of the contributions of each component determines the FP of each *net episode*.
6. *Calculate the functional size*. From the sum of the FP of all the *net episodes*, the FP of the system is obtained.

4. STATISTICAL ANALYSIS OF THE FP MEASUREMENT DATA

Measurement data

The technique described was applied to the L&S of the cases: *Saving plan for Automobile Acquisition System* [18]; *Hotel Reception System* [14]; *Argentine Passports Emission System* [19]; *Meeting Scheduler System* [20]; *Blood Bank System* [21]; *Service Station System* [22]; *L&S for the L&S construction processes* [23]. The obtained data were assigned to two different groups:

1. Quantity of scenarios, *total*, *discarded* and *net episodes*.
2. Quantity of *DET* and *referenced resources* identified in the components of each *episode* and that derive in the measure of FP.

The groups of generated data can be analyzed in two levels: *intracase* or *intercase*. This work is related to the second level. The objective is to describe an estimate model relying on mathematical equations. Specifically, the statistical analysis of the obtained data in the measuring process is proposed. Table 1 summarizes the resulting values of the measurements.

Case	*Total Scenarios*	*Total Episodes*	*Net Episodes*	*FP*
Saving Plan	18	54	23	79
Reception	10	64	18	103
Passport	24	226	27	125
Meeting Scheduler	16	109	34	149
Blood Bank	14	84	45	180
Service Station	26	231	49	268
L&S of L&S	64	277	119	437

Table 1. FP measurement data

Analysis of the Net Episodes - FP Relationship

In this section the pairs of values *net episodes (NE) - FP* are analyzed, in order to explore the relationship that presumably exists between both variables. The *regression analysis* is a statistical technique for the modeling and the investigation of the relationship between two or more variables [24]. Linear regression is used to predict the state of a dependent variable starting from the value of a predictor variable (independent variable).

Given *n* pairs of observations $(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)$, each pair can be represented as a point of coordinates (x_i, y_i) in a *scatter diagram*. Figure 1 presents the scatter diagram which allows visualizing the distribution of the *NE – FP* data points corresponding to the seven cases.

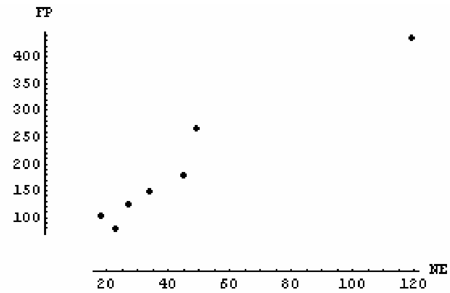

Figure 1. Scatter diagram for the pairs of *NE – FP* data of Table 1

Note: For the *regression analysis* and the graphics, the *Mathematica Version 4.2* software was used [25].

If the relationship between *x* and *y* is linear, the value of *y* for each value of *x* is represented by:

$$y = \beta_0 + \beta_1 x + e \quad (1)$$

being β_0 and β_1: *regression coefficients*, β_0 corresponds to the intersection with the *y* axis, β_1 is the slope of the straight line and *e* is assumed to be an error with mean 0 and variance (σ^2) unknown [24].

The estimate of the parameters β_0 and β_1 in the Eq. (1) minimizes the sum of the squares of the vertical deviations. This approach, denominated *method of least squares* [24], allows obtaining the estimators $\hat{\beta}_0$ and $\hat{\beta}_1$. The estimated regression line is therefore:

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x \quad (2)$$

Each pair of observations satisfies $y_i = \hat{\beta}_0 + \hat{\beta}_1 x_i + e_i$, $i = 1, 2, \ldots, n$ where $e_i = y_i - \hat{y}_i$ is called *residual* and it describes the error in the fit of the model to the *ith* observation y_i [24].

By means of the functions of the module *Statistics "Linear Regression"* of *Mathematica*, a straight line with the best adjustment for the set of data is obtained.

Figure 2[2] presents the fitted regression line for the set of pairs of values. The vertical deviations are indicated with vertical bars from each data point until the regression straight line.

[2] The *regression analysis* is omitted since an alternative analysis is proposed next.

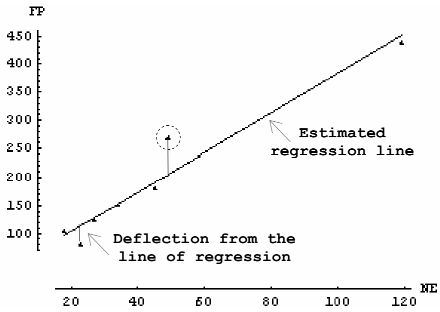

Figure 2. Regression straight line for the set of 7 pairs of data *NE - FP*

The pair (49, 268) indicated with a circle (Figure 2) stands out for its dispersion with regard to the adjusted straight line. This pair corresponds to the "Service Station" case, in which several *episodes* make reference to the technology to be used, resulting in a greater contribution of FP compared with the other cases. Although at first sight it is presented as a particular case, this is not really a limitation of the technique, since in later stages it will tend to balance. Discarded the modification of the L&S, for the approach of respecting the original version, it was decided to omit the case and to adjust the regression straight line considering the remaining six pairs of data. Table 2 shows the results of linear *regression analysis* for that set of data.

		Estimate	SE	TStat	PValue
ParameterTable →	1	25.6208	10.4332	2.45569	0.0700151 ,
	x	3.45592	0.185775	18.6027	0.0000491503

RSquared → 0.988573, AdjustedRSquared → 0.985717, EstimatedVariance → 246.12,

		DF	SumOfSq	MeanSq	FRatio	PValue
ANOVATable →	Model	1	85172.4	85172.4	346.061	0.0000491503 ,
	Error	4	984.478	246.12		
	Total	5	86156.8			

FitResiduals → {15.1726, -26.107, 6.06932, 5.87786, -1.13728, 0.124474},

	Observed	Predicted	SE	CI
	103.	87.8274	17.6372	{38.8586, 136.796}
	79.	105.107	17.4025	{56.7899, 153.424}
SinglePredictionCITable →	125.	118.931	17.2484	{71.0413, 166.82} ,
	149.	143.122	17.0536	{95.7738, 190.47}
	180.	181.137	16.9456	{134.089, 228.186}
	437.	436.876	21.8986	{376.075, 497.676}

Table 2. Report of *regression analysis* for $y_i = \beta_0 + \beta_1 x_i + e_i$ *in Mathematica*

Description of Table 2 [25]

ParameterTable

- *Estimate*: estimated value of the *regression coefficients* β_0 and β_1.
- *SE*: estimated standard error for β_0: $SE\left(\hat{\beta}_0\right)=\sqrt{\sigma^2\left[\frac{1}{n}+\frac{\bar{x}^2}{S_{xx}}\right]}$ and β_1: $SE\left(\hat{\beta}_1\right)=\sqrt{\frac{\sigma^2}{S_{xx}}}$, being $S_{xx}=\sum x^2-\frac{\left(\sum x\right)^2}{n}$
- *TStat:* statistical *t*. Some problems require deciding if a sentence about some parameter should be accepted or rejected. The sentence is denominated hypothesis and the procedure to decide about the hypothesis is denominated *hypothesis test* [24]. This considers a *null hypothesis (H_0)* and an *alternative hypothesis (H_1)*. H_0 is a particular hypothesis that is tried to be proved and H_1 defines other feasible conditions and different from which is tried to be proved.
- *PValue*: in the *hypothesis test*, rejecting H_0 when is true it is defined as a *type I error*. The probability of making a *type I error* is denoted by α. The probability of the *type I error* is called the *significance level,* or α-*error*. P-Value is the smallest significance level that could take to reject H_0 with a given data. It is calculated comparing the statistical obtained with the distribution *t* for *n - p* degrees of freedom, being *n* the size of the sample and *p* the quantity of predictors.
- *RSquared*: *coefficient of determination* R^2 (square of the *correlation coefficient*).
- *AdjustedRSquared*: *adjusted coefficient of determination*: $\bar{R}^2 = 1-\left(\frac{n-1}{n-p}\right)\left(1-R^2\right)$
- *EstimatedVariance*: residual mean square.

ANOVATable: a table for *analysis of variance*; it compares the regression model with the model represented by the data. It is used to prove the significance of the regression.

- *DF*: degrees of freedom, expresses, for a certain parameter, the number of data effectively available to evaluate the quantity of contained information in this parameter.
- *SumOfSq*. *Model*: sum of the squares of the difference between the values considered by the model and the mean of the observed values. *Error*: sum of squared residuals.
- *MeanSq*: mean of the squares due to the model (*Model*) and to the residuals (*Error*).The residual mean square is also available in *EstimatedVariance*, and is calculated by dividing the residual sum of squares by its degrees of freedom.
- *FRatio*: compares both models using the ratio of their mean squares (column *MeanSq*). The value *F* is used in the *hypothesis test*.

FitResiduals: difference between the observed and estimated values by the model.

SinglePredictionCITable: each line of the table represents the *confidence interval* to predict a value corresponding to the predicting variable. In this case the confidence level is of 0.95.

ParameterCITable. *CI*: *confidence intervals* for the estimated coefficients β_0 and β_1 based on the distribution *t*. It can be observed that *0* is a possible value for β_0 ([-3.34649, 54.5881]) for which the straight line could go by the origin, although this one is outside the experimentation interval of the *net episodes* ([18, 119]).

Linear regression model: Replacing β_0 and β_1 values from Table 2 into Eq. (2), results:

$$\hat{y} = 25.6208 + 3.45592\,x \qquad (3)$$

This model is plotted in Figure 3 together with the data points (it doesn't include the data of the "Service Station" case). For this analysis x represents *NE* and $\hat{y}$ the estimated value of FP. In the rest of the text we will refer to x and $\hat{y}$ considering the meaning mentioned.

To make inferences from a linear regression model, appropriate statistical methods are required. The validity of the inferences depends on that certain assumptions are satisfied, based on that the distribution of the errors is normal, with mean 0 and constant variance. It is also supposed that the linear model is correct, that is, the real phenomenon has a linear behavior [24].

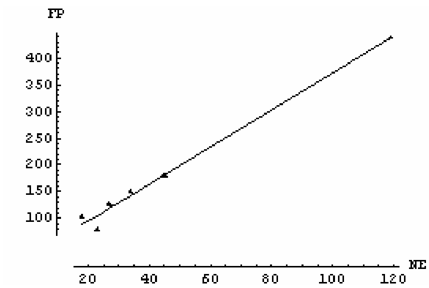

Figure 3. Regression straight line for the set of 6 pairs of data *NE - FP*

The relationship between the modeling variables by means of the regression straight line is only valid inside the experimentation range, that is, outside that rank the certainty diminishes about the validity of the assumed model.
The regression models are not necessarily valid for extrapolation purposes [24]. In this case the estimates of FP should not be extended outside the range [18, 119] *net episodes.*

Evaluation of the suitability of the linear regression model

Estimate of the variance: A way of verifying the relationship between x and y is to know how much y varies for a given value of x, that is, it is required to know the value of the variance (σ^2) which measures the variability of the values of y around the least squares line. The variance can be estimated starting from the sum of the squares of the errors. From the *regression analysis* (Table 2) s^2 = 246.12 (s^2 is the sample variance and σ^2 the population variance) is obtained, then s = 15.6882. It can be expected that the majority of the observations are included inside 2s of its respective estimated values [26]. Figure 4 presents the regression straight line and each data point with the corresponding bar ± 2s, where the supposition mentioned before is verified.

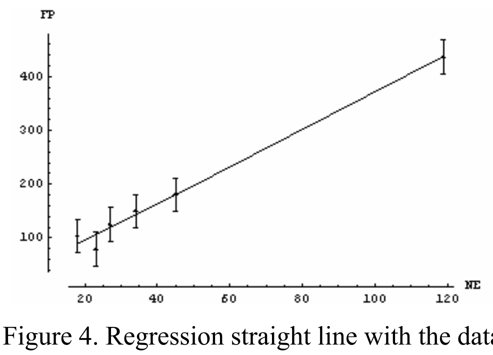

Figure 4. Regression straight line with the data points and the corresponding bar ± 2s

Hypothesis test: To determine if the linear model is a reliable tool to estimate y from a given value of x, one can use a statistical procedure - *hypothesis test* or *confidence intervals* - [26].
The model being $y = \beta_0 + \beta_1 x + e$, where e is the error and it is considered to have a normal distribution with mean 0 and variance σ^2. If x and y are not related, for y to be independent of x, the slope β_1 of the straight line should be similar to 0. To prove the *null hypothesis* such that x doesn't contribute with information for the prediction of y as opposed to the alternative that those variables are linearly related, it should be demonstrated:

$$H_0: \beta_1 = 0, H_1: \beta_1 \neq 0$$

For this the statistical t, whose value is 18.6027, is used (*TStat*, Table 2). This value should be compared with the critical value obtained from tables. This is represented by the value P (*PValue*, Table 2). In this case n = 6 and p = 2. This loss of two degrees of freedom is explained because the *coefficients of regression* β_0 and β_1 should be replaced by their estimates of least squares. Generally a value $P < 0.05$ is an evidence to reject the *null hypothesis*, which implies to accept the *alternative hypothesis*, that is, the slope is different from zero [26]. In this case $P = 0.0000491503$.
Also the statistical F (*FRatio*, Table 2) can be used to prove the *null hypothesis*. In this case $F = 346.061$ for which $P = 0.0000491503$. The value of P for the statistical F is an indicator of the low probability that the hypothesis H_0 is true, or what is the same, is the argument to reject it, which implies that a linear relationship exists between x and y. Both procedures, the test by means of the statistical t and F, drive to the same conclusions.

Correlation coefficient: Another way of measuring the strength of the linear relationship between x and y is to calculate the correlation coefficient R. The values of R are always included between -1 and 1. A value of R next or similar to 0 means little or no linear relationship between x and y. For the set of *NE – FP* pairs, their value is $R = 0,99427029$. It should be kept in mind that a high correlation doesn't imply causality, the only valid conclusion is that a linear relationship can exist between x and y [26].

Coefficient of determination: An alternative measure of how well the least squares line fits the sample data is the *coefficient of determination* R^2 (*RSquared*, Table 2). This coefficient values how much the prediction errors of y can be decreased using the information provided by x. Its value is R^2, in consequence is always included between 0 and 1. The *coefficient of determination* quantifies the variation of the error when the least squares equation is used to estimate y instead of the mean. In this case its value is R^2 =

0.988573, which means that the prediction error when using the linear model decreases in 98.86%.

The results obtained when applying the statistical approaches recommended to evaluate a regression model allows concluding that the adopted linear model is appropriate for the range included between 18 and 119 *net episodes*.

Table 3 presents a partial view of the results obtained in *Mathematica* including the seven cases. A brief comparative analysis with the results of Table 2 evidence that R^2 is smaller (*0.940357*) and that the intervals are wider, which reflects the impact when considering the “Service Station” case.

RSquared→0.940357, AdjustedRSquared→0.928428, EstimatedVariance→1109.03,
FitResiduals→{5.84172, -35.6422, -3.62933, -4.10681, -11.5714, 62.4414, -13.3334},

SinglePredictionCITable→

Observed	Predicted	SE	CI
103.	97.1583	37.1556	{1.6469, 192.67}
79.	114.642	36.6406	{20.4545, 208.83}
125.	128.629	36.3004	{35.3163, 221.942}
149.	153.107	35.864	{60.9154, 245.298}
180.	191.571	35.6014	{100.055, 283.088}
268.	205.559	35.6363	{113.953, 297.164}
437.	450.333	46.0091	{332.063, 568.604}

Table 3. Report of the *regression analysis* including the “Service Station” case

After verifying statistically the validity of the linear model, it will be used for estimation [26].

The use of the model to estimate the FP

If x_0 is the value of the predictor of interest, then $\hat{y}_0 = \hat{\beta}_0 + \hat{\beta}_1 x_0$ is the estimator of the future value [24]. That is, given a particular value of *NE*, it can be considered the value of FP by means of the pattern:

$$FP = 25.6208 + 3.45592\ NE \qquad (4)$$

The *prediction intervals* provide a range of values, within which a future observation is expected to be included with a certain probability (or trust). The column *CI* of Table 2 presents those intervals with a confidence level of 95% for the data points. Figure 5 includes the data points of the measurement, the regression straight line and the *prediction intervals* in dotted lines.

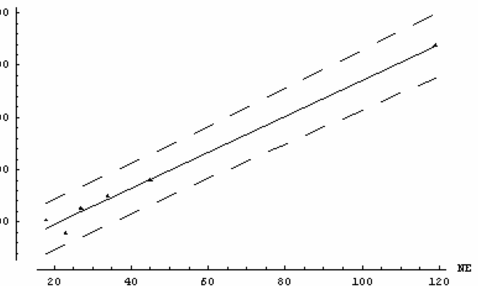

Figure 5. Straight line and *prediction intervals* for the model of *linear regression*

In general the amplitude of the *prediction intervals* increases as the value of x moves away from the mean value ($\bar{x}$). It should be noticed that the intervals are relatively wide and this can be attributed to the scarce quantity of data of the measurements.

The *prediction interval* is considered by means of the following formula [26]:

$$\hat{y}\ \pm (t_{0.025})\ s\sqrt{1+\frac{1}{n}+\frac{(x-\bar{x})^2}{S_{xx}}} \qquad (5)$$

s: standard deviation.

t: statistical *t* for α = 0.05, 4 degrees of freedom (6-2); *t* can be obtained from statistical tables [24].

α: *significance level*, is related with the degree of certainty required to reject H_0 in favor of H_1. For α = 0.05 the probability of rejecting H_0 incorrectly is of 5%.

$t_{\alpha/2} = 0.025$ = 2.776 [24], s = 15.6882, n = 6,

$\bar{x} = 44{,}33333$, $S_{xx} = \sum x^2 - \frac{(\sum x)^2}{n} = 7131{,}33333$.

Replacing in (5), results the following expression:

$$\hat{y} \pm 2.776 * 15.6882 \sqrt{1+\frac{1}{6}+\frac{(x-44.33333)^2}{7131{,}33333}} \qquad (6)$$

Example: Estimate of the FP and *prediction interval* for *NE = 49.*

Using the regression model described in Eq. (4) the FP are calculated:

$$FP = 25.6208 + 3.45592 * 49 = 194.961$$

Substituting the $\hat{y}$ and x values by the *FP* and *NE* current values in (6), the *prediction interval* 194.961 ± 47.1014 is obtained, whose result is [148, 242]. The Service Station has *49 NE* and although it was discarded from the *regression analysis*, the estimate of FP is not very different from the measured value (268).

5. CONCLUSIONS AND FUTURE WORKS

Starting from the measurement of the *functional size* of the scenarios, an FP estimate model of a system was described using the *regression analysis*. The suitability of the model was revised according to the practices recommended in the bibliography. The value of the *correlation coefficient* (0.99) indicates a strong linear relationship between the data and the *coefficient of determination* indicates that the estimate error decreases 98.86% when using the linear model. The analysis of variance allows verifying that most of the observations are included within ± 2 standard deviation of the respective values estimated by the regression straight line. The *hypothesis test* also confirms the validity of the adopted model. It can be concluded that the linear model is suitable for the available data.

The small number of measurements represents a restriction to affirm that this model will be convenient in all the cases. Anyway, we will replicate the analysis scheme with new data cases. The results are encouraging since they show interesting relationships that will be confirmed or adjusted in the future. It is necessary to repeat that the estimates will only be possible in the range that the *regression analysis* was applied: set of scenarios with 18 to 119 *net episodes*.

The main conclusion is that, if the proposed model is valid, it can estimate the size of an application in a very early stage of development, starting from L&S. To have this measure in FP allows making estimates of effort, cost, personnel and schedule of the project.

On the other hand, the analysis of the studied cases doesn't suggest the existence of a relation between the quantity of scenarios and the FP. There exist cases with few scenarios and many *episodes* and inversely, so it could be supposed that this characteristic is dependent of the nature of the application.

Among the related future topics of investigation figure to evaluate non-linear models and the possibility of establishing an estimate model starting from the *total episodes*. This last one would allow making remarkably agile the FP estimation. On the other hand, we have to advance in the analysis of "the internal" data of each case in order to discover relations between items that compose the *episodes*.

This work is part of a wider proposal which includes: to calculate the FP for a wider spectrum of cases in order to improve the estimates, to investigate the possibility of adapting the proposal to the IFPUG approach, to build a tool CASE which supports the process and to measure the effort required by the process of accountability FP on L&S.

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