

Regression and Residual Analysis of the Use of the Montessori Cylinder Block as a Screening Test Instrument for Developmental Disorders (1)

— About the Relationship to the Chronological Age —

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Abstract

It was confirmed that in following three cases for children under forty-eight months of age the fitted regression curve can not be determined because the time required to inset all Montessori cylinders into the block is too varied.

(1) The subjects are sixty-five children whose DQs of three areas—Postural-Motor Area, Cognitive-Adaptive Area and Language-Social Area—of the Kyoto Scale of Psychological Development are over 80.

(2) The subjects are sixty children whose DQ of total area of the Kyoto Scale of Psychological Development is over 90.

(3) The subjects are forty-four children whose DQs of three areas—Postural-Motor Area, Cognitive-Adaptive Area and Language-Social Area—of the Kyoto Scale of Psychological Development are over 90.

Key words: Cylinder, Montessori, Regression, Residual

Introduction

A previous paper concerning the Montessori cylinder block B type (Azuma, 1994, submitted for publication) examined the relationship between children's chronological ages and the time required of children inseting all the cylinders into the block. It was determined that for children under forty-eight months of age the fitted regression curve could not be determined because the time required to inset all cylinders into the block was too varied. The subjects selected in that paper were seventy-five normal children who were from four to six years old. Their DQ of total area which were measured by the Kyoto Scale of Psychological Development were above eighty.

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The purpose of this paper is to confirm the following point. It is that in following three cases for children under forty-eight months of age the fitted regression curve can not be determined because the time required to inset all cylinders into the block is too varied.

(1) The subjects are sixty-five children whose DQs of three areas--Postural-Motor Area, Cognitive-Adaptive Area and Language-Social Area--of the Kyoto Scale of Psychological Development are over 80.

(2) The subjects are sixty children whose DQ of total area of the Kyoto Scale of Psychological Development is over 90.

(3) The subjects are forty-four children whose DQs of three areas—Postural-Motor Area, Cognitive-Adaptive Area and Language-Social Area—of the Kyoto Scale of Psychological Development are over 90.

Method

To examine the application of these regression curves to observational values the residuals were analyzed. The hypothesis that the estimate regression coefficients were zero was tested.

Results and Discussion

Case 1. The subjects are sixty-five children whose DQs of three areas-- Postural-Motor Area, Cognitive-Adaptive Area and Language-Social Area--of the Kyoto Scale of Psychological Development are over 80.

Figure 1 showed the nonlinear regression curve, the curve formula and the scatter diagram. Figure 2 showed the residual analysis of the nonlinear regression curve. Figure 2 showed that under forty-eight months of age the fitted regression curve could not be determined because the time required to inset all cylinders into the block was too varied.

Table 1 showed the result of testing the hypothesis that the estimate regression coefficients were zero. The significant probability of term X^2 was 4.85% and significant. But 4.85% was near to 5% and the linear regression curve was calculated.

Figure 3 showed the linear regression curve, the curve formula and the scatter diagram. Figure 4 showed the residual analysis of the linear regression curve. Figure 4 showed that under forty-eight months of age the fitted regression curve could not be determined because the time required to inset all cylinders into the block was too varied.

Case 2. The subjects are sixty children whose DQ of total area of the Kyoto Scale of Psychological Development is over 90.

Figure 5 showed the nonlinear regression curve, the curve formula and the scatter diagram. Figure 6 showed the residual analysis of the nonlinear regression curve. Figure 6 showed that under forty-eight months of age the fitted regression curve could not be determined because the time required to inset all cylinders into the block was too varied.

Table 2 showed the result of testing the hypothesis that the estimate regression coefficients were

zero. The significant probability of term X^2 was 5.25% and not significant. The linear regression curve was calculated.

Figure 7 showed the linear regression curve, the curve formula and the scatter diagram. Figure 8 showed the residual analysis of the linear regression curve. Figure 8 showed that under forty-eight months of age the fitted regression curve could not be determined because the time required to inset all cylinders into the block was too varied.

Case 3. The subjects are forty-four children whose DQs of three areas-- Postural-Motor Area, Cognitive-Adaptive Area and Language-Social Area--of the Kyoto Scale of Psychological Development are over 90.

Figure 9 showed the nonlinear regression curve, the curve formula and the scatter diagram. Figure 10 showed the residual analysis of the nonlinear regression curve. Figure 10 showed that under forty-eight months of age the fitted regression curve could not be determined because the time required to inset all cylinders into the block was too varied.

Table 3 showed the result of testing the hypothesis that the estimate regression coefficients were zero. The significant probability of term X^2 was 5.84% and not significant. The linear regression curve was calculated.

Figure 11 showed the linear regression curve, the curve formula and the scatter diagram. Figure 12 showed the residual analysis of the linear regression curve. Figure 12 showed that under forty-eight months of age the fitted regression curve could not be determined because the time required to inset all cylinders into the block was too varied.

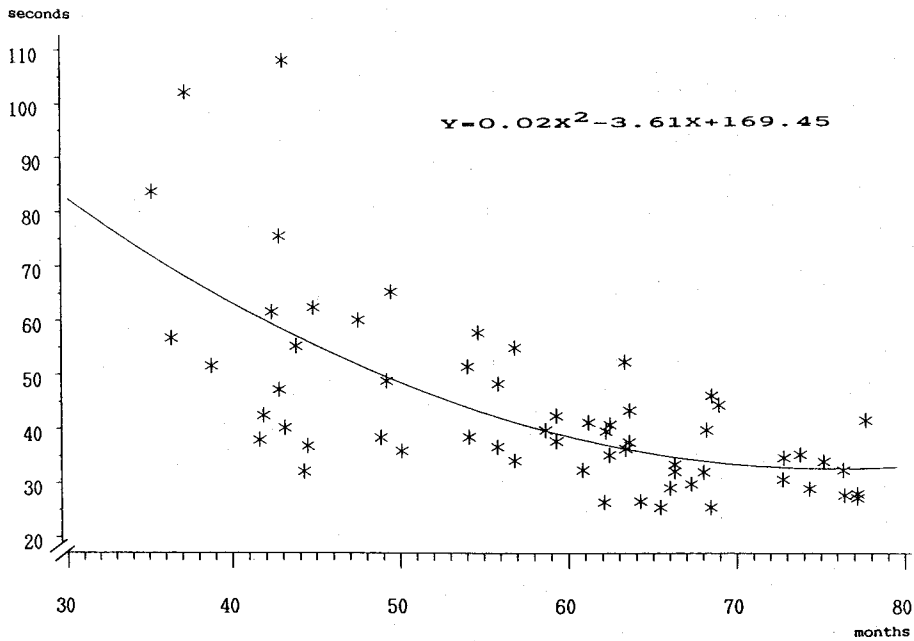


Figure 1. The nonlinear regression curve, the curve formula, and the scatter diagram (65 children whose DQs of three areas are over 80)

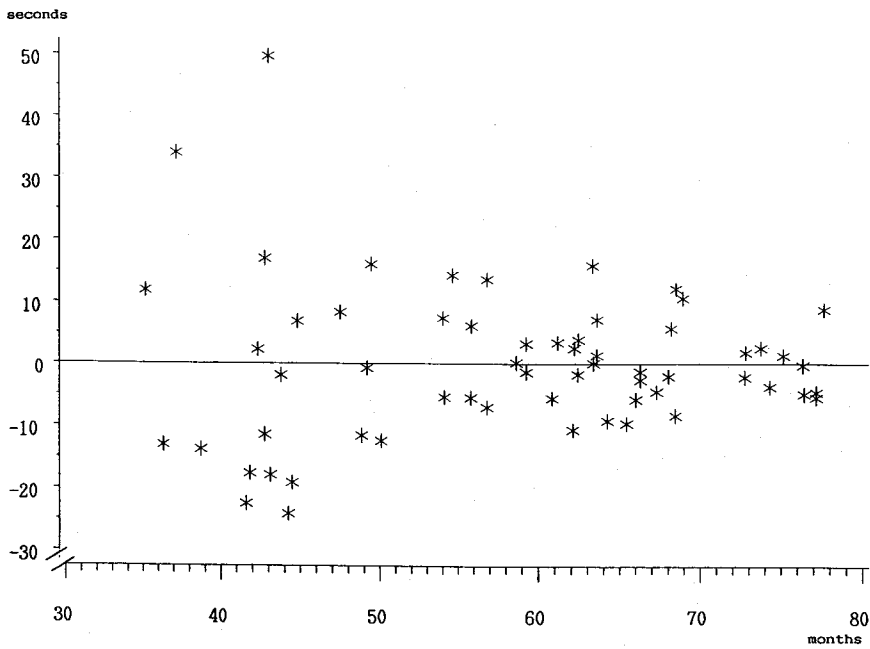


Figure 2. The residual analysis of the nonlinear regression curve. (65 children whose DQs of three areas are over 80)

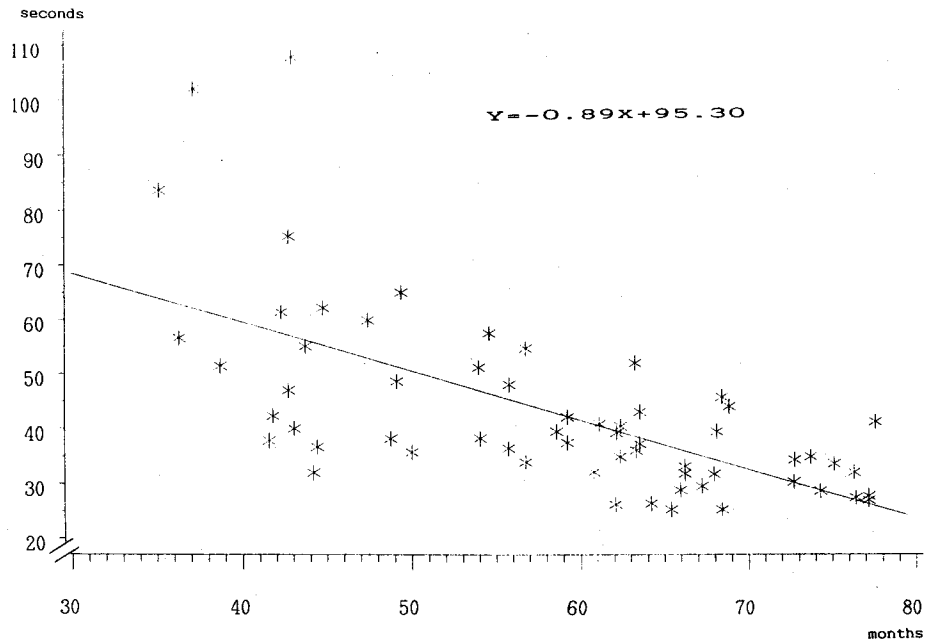


Figure 3. The linear regression curve, the curve formula, and the scatter diagram (65 children whose DQs of three areas are over 80)

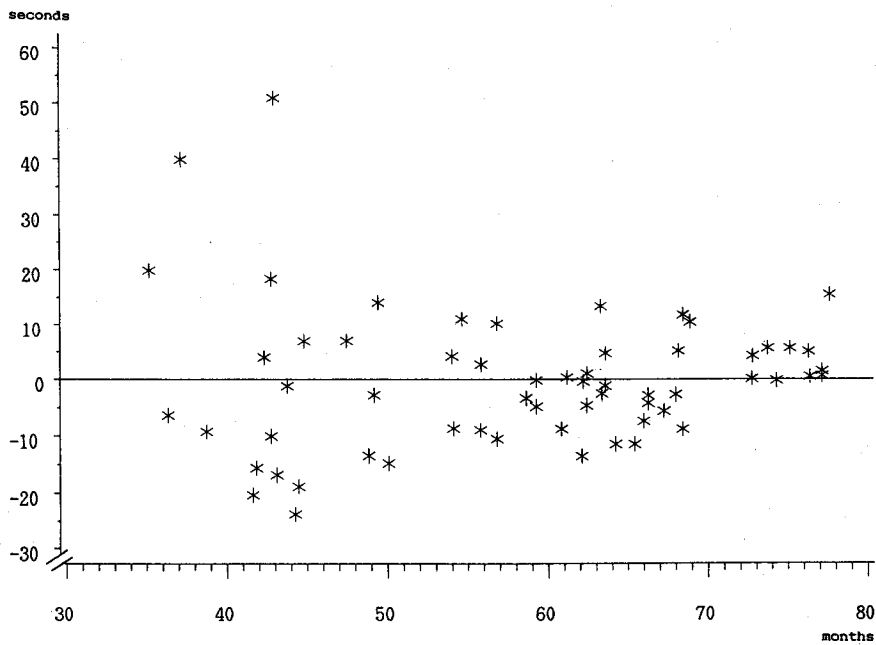


Figure 4. The residual analysis of the linear regression curve. (65 children whose DQs of three areas are over 80)

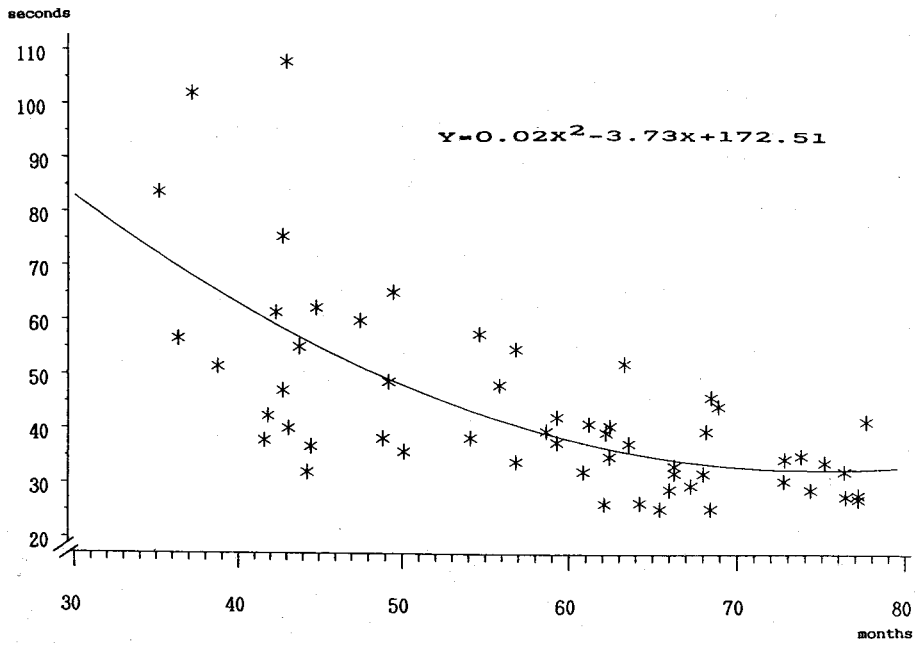


Figure 5. The nonlinear regression curve, the curve formula, and the scatter diagram (60 children whose DQ of total area is over 90)

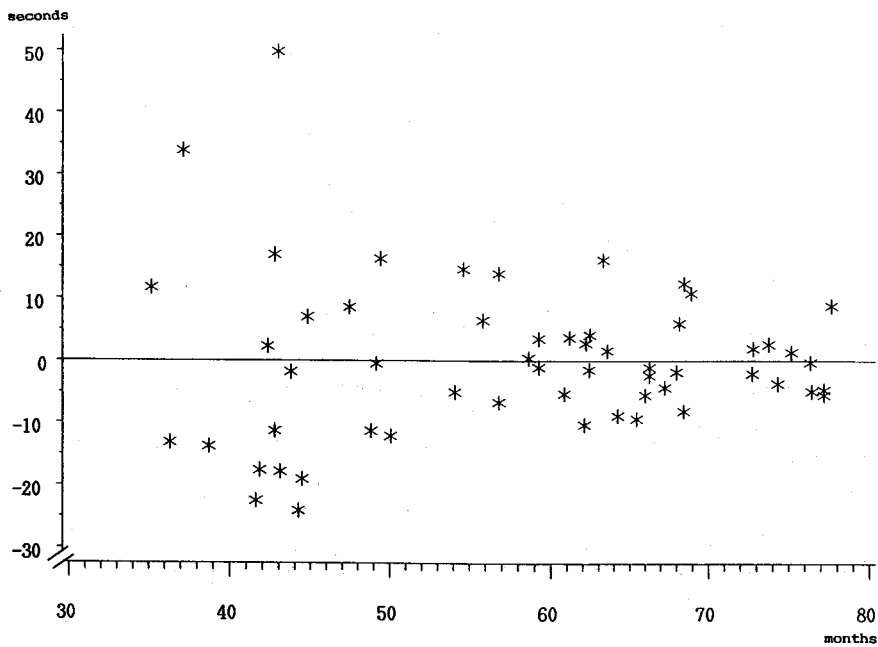


Figure 6. The residual analysis of the nonlinear regression curve. (60 children whose DQ of total area is over 90)

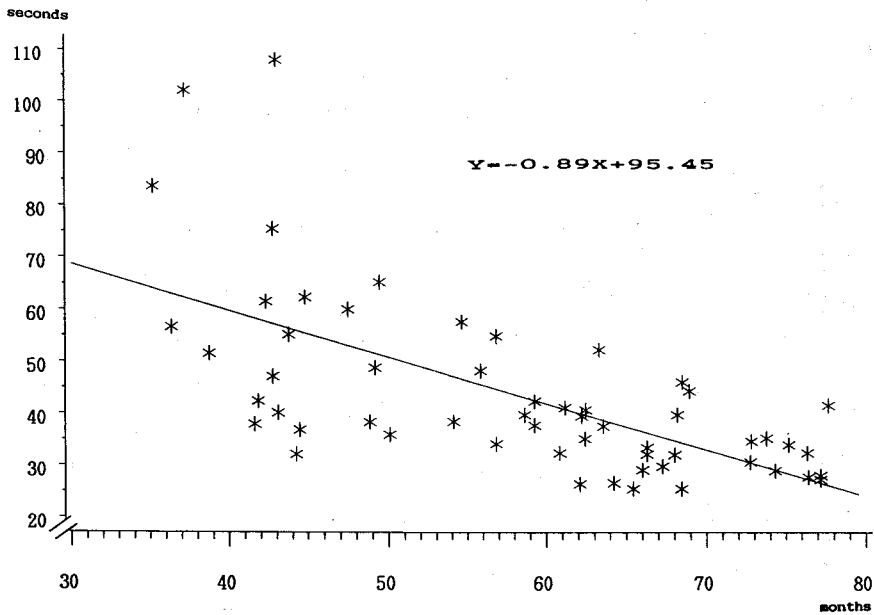


Figure 7. The linear regression curve, the curve formula, and the scatter diagram (60 children whose DQ of total area is over 90)

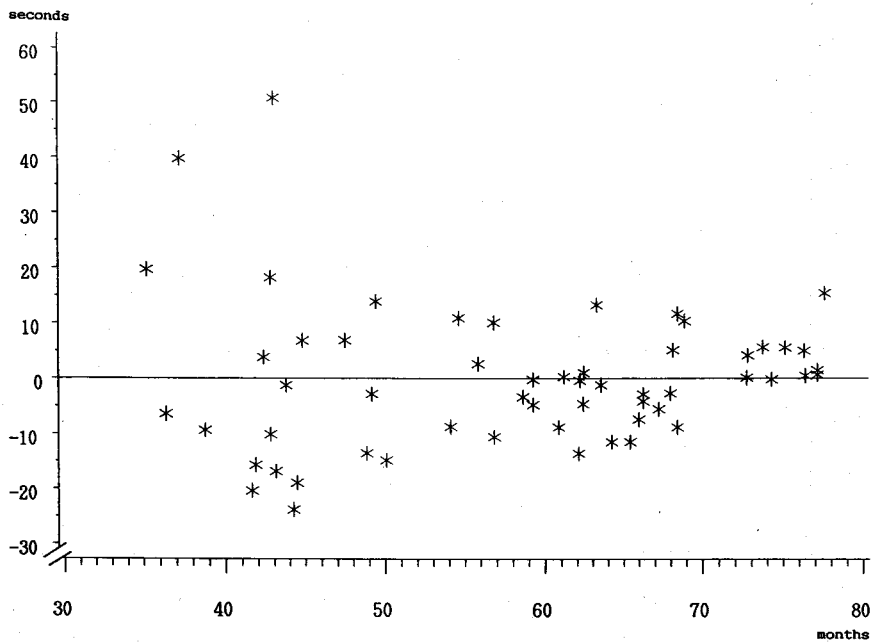


Figure 8. The residual analysis of the linear regression curve. (60 children whose DQ of total area is over 90)

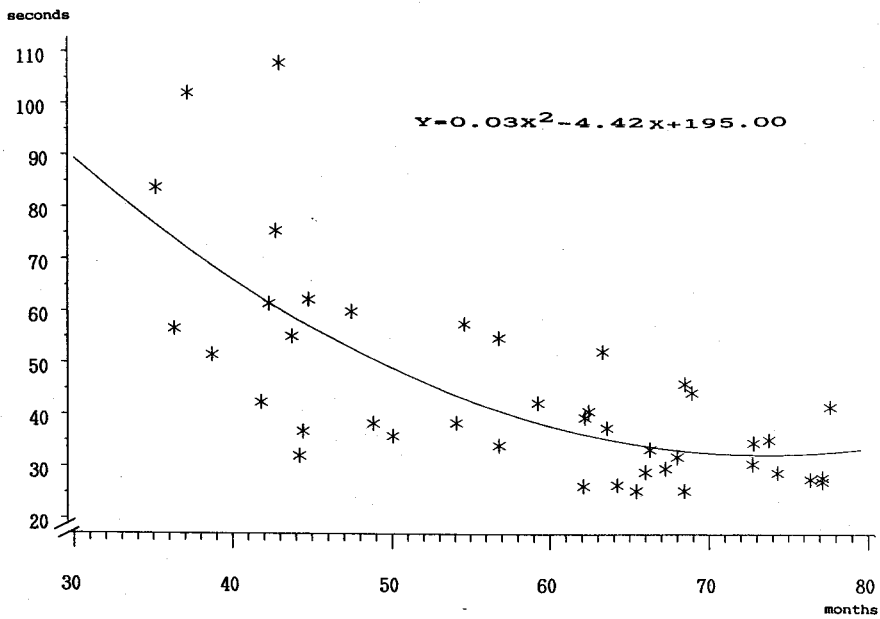


Figure 9. The nonlinear regression curve, the curve formula, and the scatter diagram (44 children whose DQs of three areas are over 90)

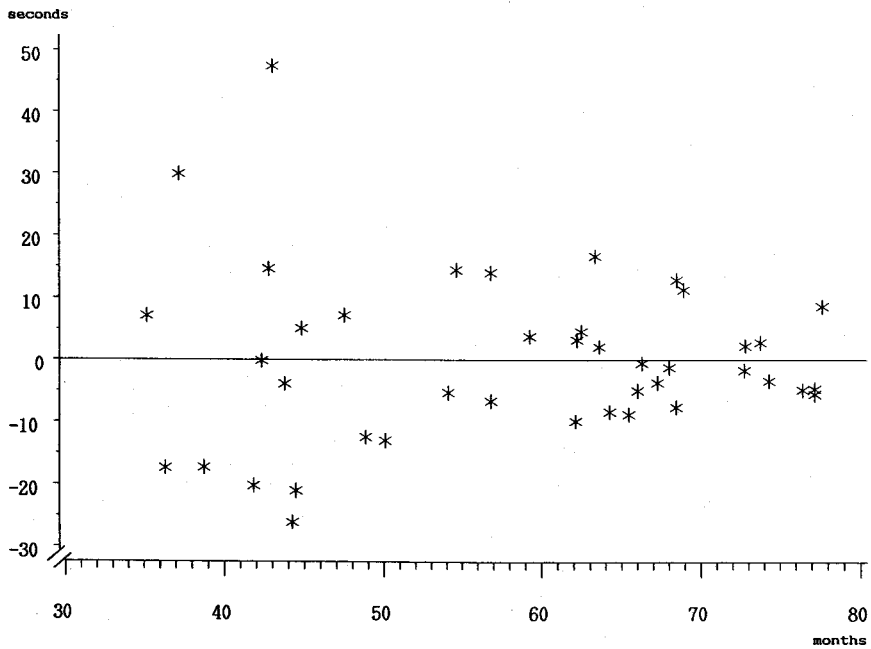


Figure10. The residual analysis of the nonlinear regression curve. (44 children whose DQs of three areas are over 90)

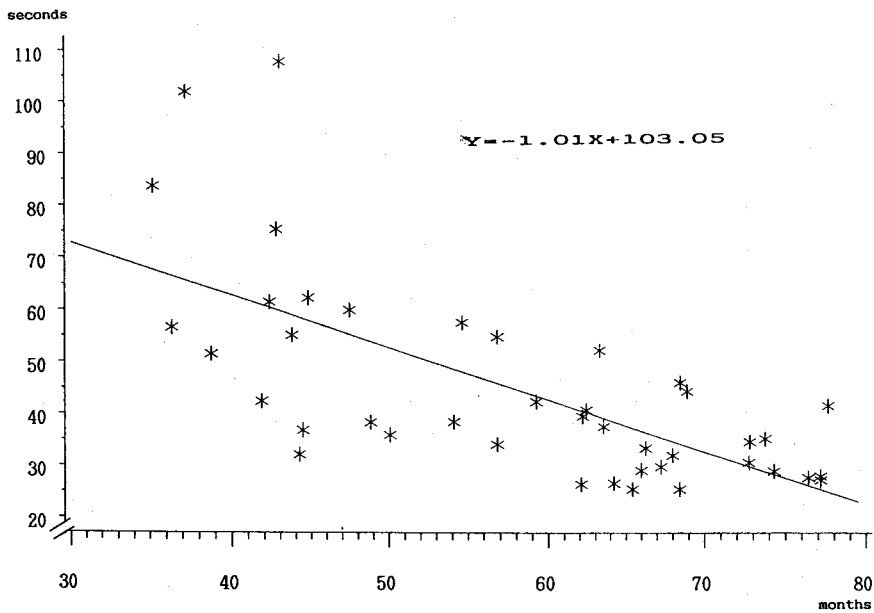


Figure11. The linear regression curve, the curve formula, and the scatter diagram (44 children whose DQs of three areas are over 90)

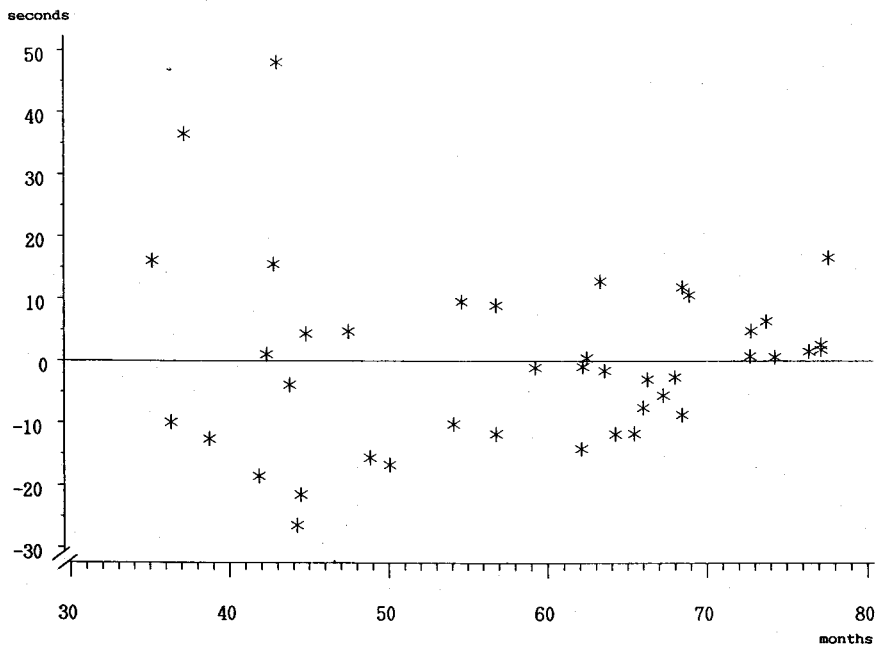


Figure12. The residual analysis of the linear regression curve. (44 children whose DQs of three areas are over 90)

Table 1 The Result of Testing the Hypothesis that the Estimate Regression Coefficients Were Zero
(65 children whose DQs of three areas are over 80)

Term	T-value	Significant probability
x^2	2.015	4.85%
x	-2.662	1.00%
Constant	4.190	0.01%

Table 2 The Result of Testing the Hypothesis that the Estimate Regression coefficients Were Zero
(60 children whose DQ of total area is over 90)

Term	T-value	Significant probability
x^2	1.980	5.28%
x	-2.592	1.23%
Constant	4.337	0.01%

Table 3 The Result of Testing the Hypothesis that the Estimate Regression Coefficients Were Zero
(44 children whose DQs of three areas are over 90)

Term	T-value	Significant probability
x^2	1.950	5.84%
x	-2.513	1.62%
Constant	4.048	0.02%