CHAPTER III

DIFFERENTIAL PREDICTIONS

In the previous two chapters, we studied the prediction of the two criterion variables, namely (1) PSc - English and (2) PSc - Mathematics. We now study the prediction of these two criterion variables differently and the prediction of the third criterion of PSc - Science, with regard to two basic predictors of SSCE English and SSCE Mathematics.

For differential prediction study, relationships of different criterion variables with the given predictor variable are examined. For instance, the relationship of the science subject with language and the relationship of the mathematics with language.

In our data, we have three main criterion variables:

1.　　PSc - English language, (say Z_1), 200 marks,
2.　　PSc - Mathematics (Z_2), 100 marks,
3.　　PSc - Science (Z_3), 450 marks

We will study differential prediction of these criterion variables with respect to SSCE - English (X_1) and SSCE Mathematics (X_2) separately. The four differential studies undertaken in this chapter are:

1)   PSc - English with SSCE-Mathematics(i.e. Z_1 with X_2)

2)   PSc - Mathematics with SSCE-English(i.e. Z_2 with X_1)

3)   PSc - Science with SSCE-English   (i.e. Z_3 with X_1)

4)   PSc - Science with SSCE-Mathematics(i.e. Z_3 with X_2)

Method

The analysis was done by the same method as given in the previous chapters and the results are presented in the following sections.

1)   PSc - English with SSCE-Mathematics (Z_1 with X_2)

The linear, quadratic and the cubic equations in transferred units (for Z_1 origin at 72 and scale of 5 and for X_2 origin at 67 and scale of 5) are-

$$Z_1 = 0.0972 + 0.3695x_2$$

$$Z_1 = -0.2238 + 0.3590x_2 + 0.0412x_2^2$$

$$Z_1 = -0.2233 + 0.1739x_2 + 0.0400x_2^2 + 0.0097x_2^3$$

The significance of these relationships is tested by following analysis of variance (Table 3.1):

Table 3.1 Testing the Significance of Each Additional Degree in Fitting of Polynomial Regression of PSc-English Marks on SSCE Mathematics Marks

Source	SS	DF	MS
Due to linear regression	296.52	1	296.52**
Excess due to quadratic	41.57	1	41.57**
Excess due to cubic	28.64	1	28.64*
Residual	1801.35	274	6.57
Total	2168.08	277	

The linear and quadratic regressions are significant at .01 level while cubic is significant at .05 level.

2)   PSc - Mathematics with SSCE-English (Z_2 with X_1)

The linear, quadratic and the cubic equations in transferred units (for Z_2, origin at 52 and scale of 5 and for X_2, origin at 57 and scale of 5) are-

$$Z_2 = -3.4582 + 0.6685x_1$$

$$Z_2 = -3.6831 + 0.6686x_1 + 0.0639x_1^2$$

$$Z_2 = -3.6798 + 0.6072x_1 + 0.0640x_1^2 + 0.0062x_1^3$$

The significance of the above equations is tested by following analysis of variance (Table 3.2):

Table 3.2 Testing the Significance of Each Additional Degree in Fitting of Polynomial Regression of PSc-Mathematics Marks with SSCE English Marks

Source	SS	DF	MS
Due to linear regression	577.41	1	577.41**
Excess due to quadratic	17.90	1	17.90
Excess due to cubic	1.67	1	1.67
Residual	3383.89	274	12.35
Total	3980.87	277	

Evidently, the linear regression is significant but neither quadratic nor cubic is significant.

3) PSc - Science with SSCE - English (Z_3 with X_1)

The linear, quadratic and the cubic equations in transferred units (for Z_3 origin at 182 and scale of 10 and for X_1, origin at 57 and scale of 5) are-

$$Z_3 = 0.0849 + 1.2701x_1$$

$$Z_3 = -0.1612 + 1.2724x_1 + 0.0693x_1^2$$

$$Z_3 = -0.1588 + 1.2230x_1 + 0.0695x_1^2 + 0.0048x_1^3$$

The significance of the above equations is tested by following analysis of variance (Table 3.3):

Table 3.3   Testing the Significance of Each Additional Degree in Fitting of Polynomial Regression of PSc-Science Marks on SSCE English Marks

Source	SS	DF	MS
Due to linear regression	1588.21	1	1588.21**
Excess due to quadratic	31.48	1	31.48
Excess due to cubic	0.81	1	0.81
Residual	5211.14	274	19.02
Total	6831.64	277	

Again, we find the linear regression significant but neither quadratic nor cubic is significant.

4)   PSc - Science with SSCE-Mathematics (Z_3 with X_2)

The linear, quadratic and the cubic equations in transferred units (for Z_3 origin at 182 and scale of 10 and for X_2 origin at 67 and scale of 5) are-

$$Z_3 = 0.0872 + 0.9911x_2$$

$$Z_3 = -0.2779 + 0.8683x_2 + 0.0482x_2^2$$

$$Z_3 = -0.3179 + 0.7911x_2 + 0.0470x_2^2 + 0.0098x_2^3$$

The significance of the above equations is tested by following analysis of variance (Table 3.4):

Table 3.4   Testing the Significance of Each Additional
            Degree in Fitting of Polynomial Regression
            of PSc-Science Marks on SSCE Mathematics
            Marks

Source	SS	DF	MS
Due to linear regression	2133.89	1	2133.89**
Excess due to quadratic	56.96	1	56.96
Excess due to cubic	29.44	1	29.44
Residual	4611.35	274	16.83
Total	6831.64	277	

The linear is significant and the quadratic though not significant, is very near to 0.5 level of significance while cubic is not significant. Improved results are obtained on the ungrouped data and so, are presented in the following analysis of variance (Table 3.5):

Table 3.5   Testing the Significance of Regressions of
Various PSc-Criterion Variables Separately
on SSCE English and Mathematics Marks

ANALYSIS OF VARIANCE

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F
1 Quadratic Regression	8640.51	2		
Linear Regression	7834.57	1		
Difference	805.94	1	805.94	4.79*
Residual	46221.88	275	168.08	
Total	54862.39	277		
2 Quadratic Regression	16333.27	2		
Linear Regression	15893.64	1		
Difference	439.63	1	439.63	
Residual	83983.35	275	305.39	1.44
Total	100316.62	277		
3 Quadratic Regression	188039.14	2		
Linear Regression	182664.58	1		
Difference	5374.56	1	5374.56	2.75
Residual	537439.70	275	1954.33	
Total	725478.84	277		
4 Quadratic Regression	237020.05	2		
Linear Regression	229852.04	1		
Difference	7168.01	1	7168.01	4.04*
Residual	488458.79	275	1776.21	
Total	725478.84	277		

*The value of F Significant at 5% level

Evidently the quadratic terms in cases of regressions of (1) PSc-English on SSCE-Mathematics and (4) PSc-Science in SSCE Mathematics are significant at 5 percent level and the contribution of quadratic term in case of (3) PSc-Science on SSCE-English, though statistically not significant, is fairly considerable.

As before, we now, examine the results on normalized variables. Normalized SSCE marks in the previous chapters were used for this purpose. The significance of the linear, quadratic and the cubic equations is tested by the following analysis of variance (Table 3.6):

Table 3.6   Testing the Significance of Various PSc-Criterion Variables Separately on Normalized SSCE-English and Mathematics Marks

ANALYSIS OF VARIANCE

(PSc-English with Normalized SSCE Mathematics Marks)

Source	SS	DF	MS
Due to linear regression	298.35	1	298.35**
Excess due to quadratic	40.00	1	40.00*
Excess due to cubic	19.17	1	19.17
Residual	1810.56	274	6.61
Total	2168.08	277	

(PSc-Mathematics on Normalized SSCE English Marks)

Source	SS	DF	MS
Due to linear regression	587.78	1	587.78**
Excess due to quadratic	13.62	1	13.62
Excess due to cubic	3.44	1	3.44
Residual	3376.03	274	12.32
Total	3980.87	277	

(PSc-Science on Normalized SSCE English Marks)

Source	SS	DF	MS
Due to linear regression	1626.07	1	1626.07**
Excess due to quadratic	20.00	1	20.00
Excess due to cubic	1.84	1	1.84
Residual	5183.73	274	18.92
Total	6831.64	277	

(PSc-Science on Normalized SSCE Mathematics Marks)

Source	SS	DF	MS
Due to linear regression	2162.31	1	2162.31**
Excess due to quadratic	47.44	1	47.44
Excess due to cubic	15.26	1	15.26
Residual	3606.63	274	13.16
Total	6831.64	277	

On comparison, we find that the results are almost similar to those found in case of raw scores.

We now study the results on standardized tests of English and Mathematical abilities, as we have done in previous chapters. The results are presented in the following analysis of variance (Table 3.7):

Table 3.7   Testing the Significance of Regressions of
Various PSc-Criterion Variables Separately
on Standardized English and Mathematics
Test Scores

ANALYSIS   OF   VARIANCE

(PSc-English with Standardized Numerical Test Scores)

Source	SS	DF	MS
Due to linear regression	186.06	1	186.06**
Excess due to quadratic	5.07	1	5.07
Excess due to cubic	10.90	1	10.90*
Residual	657.69	348	1.87
Total	859.72	351	

(PSc-Mathematics with Standardized English Test Scores)

	SS	DF	MS
Due to linear regression	462.11	1	462.11**
Excess due to quadratic	13.80	1	13.80
Excess due to cubic	0.02	1	0.02
Residual	4738.97	348	13.62
Total	5214.90	351	

(PSc-Science with Standardized English Test Scores)

	SS	DF	MS
Due to linear regression	254.17	1	254.17**
Excess due to quadratic	0.0	1	0.0
Excess due to cubic	1.67	1	1.67
Residual	1601.15	348	4.60
Total	1856.99	351	

(PSc-Science on Standardized Numerical Test Scores)

	SS	DF	MS
Due to linear regression	477.29	1	477.29**
Excess due to quadratic	16.33	1	16.33*
Excess due to cubic	10.35	1	10.35
Residual	1353.02	348	3.89
Total	1856.99	351	

The results obtained on ungrouped data are given

in Table 3.8 as follows:

Table 3.8 Testing the Significance of Regressions of Various PSc-Criterion Variables Separately on Standardized English and Mathematics Test Scores (Un-grouped)

ANALYSIS OF VARIANCE

(PSc-English with Standardized Numerical Test Scores)

Source	SS	DF	MS	F
Quadratic regression	5110.94	2		
Linear regression	4959.40	1		
Difference	151.54	1	151.54	3.19
Residual	16592.04	349	47.54	
Total	21702.98	351		

(PSc-Mathematics with Standardized English Test Scores)

Quadratic regression	10441.64	2		
Linear regression	10193.60	1		
Difference	248.04	1	248.04	0.72
Residual	119793.45	349	343.25	
Total	130135.09	351		

(PSc-Science with Standardized English Test Scores)

Quadratic regression	6295.42	2		
Linear regression	6290.38	1		
Difference	5.04	1	5.04	0.04
Residual	39525.66	349	113.25	
Total	45821.08	351		

(PSc-Science with Standardized Numerical Test Scores)

Quadratic regression	12596.62	2		
Linear regression	12135.05	1		
Difference	461.57	1	461.57	4.85
Residual	33224.46	349	95.20	
Total	45821.08	351		

Comparing the results obtained with the achievement measures and with the aptitude measures, we observe that the overall trends of relationships are almost similar except a few deviations which occur at some points.

Conclusions:

1. In prediction of PSc-English from SSCE-Mathematics quadratic term and to a lesser extent cubic term come out significant over evidently significant linear regression but the significance of the cubic term is reduced when SSCE-Mathematics marks are normalized, while in case of standardized numerical test scores cubic term remains significant and the significance of quadratic term is lessened.

2. In prediction of PSc-Mathematics from SSCE-English marks, only the linear regression is significant and neither quadratic nor cubic comes out significant. This results also holds good in case of normalized SSCE-English marks and standardized English test scores.

3. In prediction of PSc-Science from SSCE-English marks again, only the linear regression is significant. The results in cases of normalized-English marks and standardized English test scores follow suit.

4.   In prediction of PSc-Science from SSCE-Mathematics
     marks (raw as well as normalized) the quadratic
     term is found to be very near to the 5 percent
     level of significance, but comes out significant
     in case of ungrouped marks, over and above the
     linear regression. Similar result is observed
     in case of standardized numerical test scores.