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POST-SECONDARY LONG-TERM COSTING MODEL

DOCUMENTATION OF THE VOLUME SIDE

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1. INTRODUCTION

The Long Term Costing Model for Post-Secondary Education (LTCM-PSE) is the second in a series of costing models to be developed in the department. The primary objective of the costing model is to provide the department with a sound and defensible methodology for projecting resource requirements and allocations and to support policy analysis.

The project is structured in two parts, volume side and cost side. QASR is responsible for the volume side of the project which consists of providing a mathematical model that will be used to project the number of enrolments for the Post-Secondary Education Assistance Program (PSEAP). The cost side is under the responsibility of Finance.

For the volume side, the project was divided into Model I and Model II. The purpose of Model I was to provide national projections pro-rated to the regional level while in Model II, projections would be performed at both national and regional levels.

The purpose of this document is to describe the methodology used to develop the volume side of the costing model. First, the initiation stage of the project which is comprised of a literature review, external and internal consultations and data acquisition will be described. Second, the results of the exploration stage which include statistical analysis of the data will be shown. Finally, the crystallization stages of Model I and Model II, i.e. the approaches proposed for short and long term forecasting of participation rates will be presented.

2. INITIATION STAGE

2.1 LITERATURE REVIEW

The Initiation Stage began with a literature search and review of projection models for education purpose. Articles from journals such as <u>Research in Higher Education</u>, <u>Canadian Journal of Higher Education</u>, <u>Lotus</u>, etc. were reviewed. A complete list of the sources examined is contained in the bibliography.

2.2 CONTACTS

Contacts with professionals both within and outside the federal government were initiated to further explore modelling options for post-secondary projections and to obtain available data. For example, Employment and Immigration Canada, Statistics Canada and the Association of Universities and Colleges of Canada were contacted. The list of contacts and products obtained from each of them is presented in Appendix A.

2.3 POST-SECONDARY DATA ACQUISITION

2.3.1 HISTORY

Since 1978/79, the information system in place for the PSEAP has been computerized. The Continuing Education Information System (CEIS) was used from 1978 to 1984 and the Post-Secondary Education Management Information System (PSEMIS) was used from 1985 until 1987. Each INAC regional office maintains its own database (manual or computerized) containing information on individual students. Both CEIS and PSEMIS were used to store aggregate information (counts only) at national and regional levels. CEIS never worked properly because of programming and technical problems. PSEMIS had software deficiencies, did not meet regional needs and has fallen into general disuse. Some information is available from the PSEMIS but, unfortunately, nobody has the necessary experience to manipulate the system and extract the information.

In 1989, for the first time, a national database with data at the student level was built. Each regional office sent a copy (computerized or written report) of their post-secondary data elements. However, each region has its own set of data elements and only a few of them are in common to all regions. In addition, some of those which are in common are coded differently. For example some regions use characters to describe the institution and others use numbers. This data base contains a lot of information but it is not uniform across regions.

2.3.2 DATA

It is difficult to assemble detailed data on postsecondary students. No national database exists (except for 1989/90) at the student level. Information (counts only) for years prior to 1989 are kept at the national level and sometimes regional level for some or all of the following basic data elements: total enrolments, C-31, UCEP (1), full-time, part-time. Different sources of data were used to build an enrolment series that contained enough data to support a forecasting model. The resulting enrolment series covers the period of 1976/77 to 1989/90.

Data for 1976/77 to 1984/85 were provided by the Education Program. For these years, only total enrolments are available at the national and regional levels.

Data for 1985/86 to 1987/88 were retrieved from the "Year End Report on Performance Indicators". Basic data elements such as total enrolments, number of full-time and part-time students, C-31's, UCEP students are available on the Performance Indicators sheets at national and regional levels.

(1) UCEP : University College Entry Program

Data for 1988/89 were provided by the Education Program. Total enrolments, number of full-time and part-time students, C-31's and UCEP students are available at the national and the regional levels.

Finally, data for year 1989/90 were obtained from the 1989/90 national data base. Various statistics such as number of full-time, part-time students, C-31's, number of dependents and age distribution are available for all regions and at the national level. Other data elements like number of UCEP/PSEAP, type of institution (university, college) are available only for few regions.

The series of enrolments (1976/77 to 1989/90) used for Model I research is presented in table 1. All the other data elements such as number of C-31 students, UCEP etc. are presented in Appendix B.

Table 1 Post-Secondary Education Enrolments 1976/77 to 1989/90

Year	Enrolments	Year	Enrolments
19 7 6	2684	1983	8062
1977	3599	1984	8567
1978	4148	1985	12164
1979	4502	1986	14914
1980	4999	1987	15921
1981	6156	1988	15572
1982	6810	1989	18535(*)

NOTE: 1976 will be used to represent the academic year of 1976/77 and so on.

(*) The 1989 enrolment figure is an estimation.

2.3.3 CONCERNS ABOUT DATA

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The most important concern is the availability of data. Few data elements are available and those which are available are only provided at an aggregated level (except for 1989). Consequently, some important statistics cannot be computed directly on the data. For example, the entry rate, which measures the proportion of new students each year in the program, cannot be derived unless new students are identified as such in a database. The same problem occurs for graduation rates and drop-out rates. An important statistic is the transfer rate from high school/UCEP to post-secondary education. Again, a lack of information on this subject prevents from calculating transfer rates.

NOTE: The region of North West Territories is excluded from the LTCM project since it has its own postsecondary assistance program.

As mentioned earlier, each regional office maintains its own post-secondary database according to its rules. Consequently, each regional office may uses definitions different from the others and this situation can lead to a lack of uniformity between data from the regions.

Regional databases generally cover INAC administered students within the region and, in most cases, include at least some information on band-administered participants as well. When bands do not report their data to regional offices, the total number of enrolments is underestimated.

...

In order to obtain more detailed information at the regional level, a letter was sent to each of the Regional Education Director requesting data such as total enrolments, number of dependents, type of institution, number of UCEP/PSEAP, etc., going back to 1985. Some regions provided data that are different from what was retrieved from the various headquarter's (HQ) sources Apparently, there is a problem of (eq. Alberta). reconciliation between regional data and HQ's data. This problem is presently under study by the Education Furthermore some regions are using a manual Program. database which makes it more difficult to retrieve historical data and can lead to some error in historical data and can lead to some error in manipulation (eg. Atlantic). Finally, Ontario Regional Office keeps track of application records instead student records. This situation can lead to double counting of students, thus overestimating the number of enrolments for this region.

Despite these concerns, it was decided to go ahead with the project and build a post-secondary enrolment projection system using what was available at this point. The experience acquired while working on the LTCM will helped to determine the kind of information which will be necessary to realize a much more sophisticated forecasting model in the future. A list of required data elements is provided in Appendix C.

3. EXPLORATION OF DATA

Descriptive analysis and various small studies have been performed on the data at the national level. The purpose of these analysis and studies was to extract all the information that could be useful for the forecasting model. This section presents the results of the analysis of the enrolment and the participation rate series and Appendix D presents the mini studies on C-31, UCEP, full-time and part-time students and also an analysis of the age distribution based on 1989/90 database.

NOTE: A detailed analysis of the data acquired via the Regional Offices is presented in a document entitled "Résultats de l'exlporation des données régionales, Document technique 90-7, AQRS, Octobre 1990".

3.1 ENROLMENT SERIES

The first thing to analyze is the shape of the enrolments series (1976 to 1989) which is represented on the next graph.



Post-secondary enrolments

The graph shows a gradual increase in enrolments from 1976 to 1984 and in 1985 there is a sudden increase. Many factors such as growing of high school completion, growth of the Indian population due to Bill C-31 implementation may have contributed to the sudden increase. Furthermore, the PSEAP begin to fund UCEP students in 1983. At this time only a few schools were offering the program. Later, the extension of the UCEP program to other schools may have causes the number of UCEP students to contribute to the sudden increase in 1985. Later in 1987, 1988 the series stop growing and decreased.

This situation can be explained by the budget cap. A certain number of students were deferred because of the budget cap. Finally, in 1989, with the removal of the cap, enrolments increased again.

It would be interesting to test if by removing C-31, UCEP or even adding the deferrals it is possible to explain the 1985 increase. However, good data on deferrals are not available and only Manitoba reported some. Furthermore, the impact of the cap is difficult to estimate by analyzing deferrals because of publicity and its effect on discouraging applications. On the other hand data on C-31 and UCEP students are available from 1985. The next graph presents the series of enrolments from which the C-31 and/or the UCEP students have been removed.



Post-secondary enrolments (removing C31 and/or UCEP)

The curve varies with the changes, but the sudden increase can still be observed in 1985 even when both C-31 and UCEP students are subtracted from the total number of enrolments. This proves that C-31 and UCEP students are not the only explanation for the sudden increase. Other factors may have contributed to the increase. For example, an increase of high school completion has been observed around 1985 (2) and this situation may also be a reason why the enrolments increased so rapidly in 1985.

3.2 PARTICIPATION RATE SERIES

The participation rate describes the total number of enrolments as a proportion of the Registered Indian (RI) population aged 18 to 34. The 18-34 group was chosen because 80 % of the Native post-secondary students belong to this group (see Appendix D, section 4).

3.2.1 CALCULATIONS

The participation rates were calculated using this formula:

Total post-secondary enrolments Registered Indian population aged 18-34

(2) Reference : Basic Departmental Data, QASR, 1989

The next graphic shows the evolution of the Registered Indian population aged 18-34 from 1976 to 2005. Historical data were used from 1976 to 1989 and projections were used for 1990 to 2005.



Registered Indian population (aged 18-34)

The graphic clearly shows the impact of the bill C-31 (1985) on the RI population. Then in 1990 the population growth begins to slow down to reach a plateau.

NOTE: The historical data were taken from the Indian Register and the population projections were taken from the medium growth scenario of the Registered Indian Population projections, INAC, 1989.

The participation rates series is presented on the next graph.



Post-secondary participation rates

The shape of the curve resembles a lot to the one observed earlier for the enrolment The series. participation rate increased slowly at the beginning to reach a point of sudden growth in 1985. The effect of the budget cap is also observed. Finally in 1989, the participation rate increased again.

This participation rate series was used in all the calculations for the model I. The series is presented along with population data in Appendix B.

3.2.2 COMPARISON WITH CANADIAN PARTICIPATION RATES

It is well known that the Native post-secondary situation behave differently then the Canadian one. In order to visualize this difference both participation rates series were compared.

Three unpublished sets of projections (A: low, B: medium and C: high) of Canadian enrolments by age and sex to 1998/90 were obtained from (STC). The last historical year is 1988/89 and the first projected year is 1989/90. Data on population counts (historical and projections by are and by sex) were also part of the package (for more details on STC projections, see Appendix E).

80 % of the canadian students are aged 18-24. However. in order to be consistent, the same formulae i.e total enrolments divided by population age 18-34 was used to compute a Canadian participation rate.

The next graph compares the Native participation rates with the Canadian participation rates (Scenario B, medium).



Participation rates Canadians vs Indians

The graphic shows that the participation of Indians to post-secondary education is below the Canadian participation. However the gap seems to narrow through the years. Effectively, the difference was .0877 in 1976 and it reduced to .0680 in 1988.

One of the main objective⁵ of PSEAP would be to encourage Indians to pursue post-secondary education and consequently, to improve the Indian participation rate until it reaches the Canadian one. In order to meet this goal, projections of the participation rate should increase over time.

4. CRYSTALLIZATION STAGE, MODEL I

Following the studies and the analysis performed in the exploration stage, the purpose of the Crystallization Stage was to decide how the information would be used to create a forecasting model. Data constraints precluded some forecasting approaches and restricted the options to use of participation and enrolment data series. Due to time constraints and because the participation data, unlike enrolment data, take population change into account, a decision was made to focus only on participation data in Model I. The study of the enrolment data and some other forecasting options will are part of Model II analysis see section 5. The purpose of Model I is to project post-secondary enrolments at the national level. Participation rates are projected and further transformed to enrolments. Enrolments are then split by full-time and part-time using ratios based on historical data.

Participation rate: total enrolments
 population aged 18-34

Enrolments = projected participation rate * projected population aged 18-34.

Full-time enrolments = enrolments * .8761

Part-time enrolments = enrolments * .1239

NOTE: The percentages of full time and part time enrolments are based on a national average of historical data (1985 to 1989). The average was computed taking into account that 95% of the UCEP students are enroled in full time study.

One of the goals of the LTCM is to provide options to the users. For the volume side of Model I, options consists of different approaches that can be chosen to project enrolments.

One short term (3 years) and three long term (10 years) forecasting approaches are presented. In all cases, the first year to be projected is 1990.

4.1 SHORT TERM FORECASTING APPROACH: Linear regression

4.1.1 DEFINITION

Regression analysis provides information on relationships between one variable referred as a response variable, and one or more other variables, called predictor variables. The purpose of the regression analysis is to express the response variable as a function of the predictor variable(s). Once such an expression is obtained, the relationship can be utilized to predict values of the response variable. In this case the response variable is participation rate and the predictor variable is time measured in years.

In order to use this approach the following assumption was made: the observed "linear" trend (based on historical data) will continue. It implies that the participation rate will increase during the next three years following the observed trend.

4.1.2 RESULTS

The results of the regression are presented in the next graph. The historical data are plotted along with the regression line and the 95 % confidence interval.



Short term forecasting approach Linear regression

The linear regression fits the observed pattern of the data. The coefficient of determination (R) is equal to .93 and the residuals are randomly distributed around zero. It means that the linear model fits well the data and explains about 93 % of the variance (details on the regression analysis are provided in Appendix F).

NOTE:

The statistic (R^{-}) can only be used when a linear is adjustment performed, otherwise it is meaningless. In order to be able to compare this approach with others that will be presented, an other measure, MAD will be introduced. MAD is the mean of the absolute deviations. The deviations are the difference between fitted and observed data. statistic The interpretation of this is the following : on average, the error made when estimating the true value is plus or minus the MAD It does not measure the percentage of value. variance explained by the approach but still gives an idea of the magnitude of the errors generated by the fit.

The MAD for the linear regression is equal to .0065. On average, the error made when estimating a participation rate with this short term approach is ± .0065.

The regression on participation rates including C-31 was compared to the regression on participation rates without C-31 and the two lines were not significantly different (see Appendix G). There was therefore no reasons to consider C-31 as a separate series.

4.1.3 CONCLUSION

The results of the regression are applied only to project for a short period of time. Given the irregular shape of the historical series, it would be to hazardous to project more then three years of enrolments using a linear technique. If projections are needed only for a short period of time, and if historical trend shows a "linear" pattern, then the regression combined with a confidence interval around the projections give good results and in addition, is easy to use .

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4.2 LONG TERM FORECASTING APPROACHES

Long term forecasting in the present context consists of projecting data for a period of ten years. When making long term forecasts, one assumes that the observed trend will continue for a certain period of time and assumptions can also be made about the future. If a part or all of what has been assumed turns out differently in the near future, then a new set of projections should be produced using the new information. Forecasts are not cast in concrete. A method of forecasting must evolve with the external factors that influence it. It should be revised and modified as required. Because of all these factors, one should use long term forecasts very carefully, taking into account all the assumptions that support the approach and maintaining a good knowledge of the situation.

For the model, three approaches are proposed for the long term forecasting of participation rates.

4.2.1 APPROACH 1: CONSTANT PARTICIPATION RATE

This approach holds the participation rate constant to the last observed value (1989/90) for the entire projection period (10 years). The observed value in 1989/90 is equal to = .1166. The results of this approach are presented in the following graph. The projected participation rates and the corresponding enrolments are provided in Appendix H.

Long term forecasting, approach 1 Constant



If one assumes that the participation rates will not decrease over the projected years then this approach corresponds to the lowest acceptable bound for participation rates. It can also be used for budgeting purpose (low bound).

4.2.2 APPROACH 2: LOGISTIC CURVE

4.2.2.1 Definition

The logistic curve is one of a large family of S-shaped curves that display slow growth at first, followed by a period of steep growth, then by a gradual decline in growth and finally by a saturation level where growth stops. The saturation level is the maximum value that the logistic curve can reach.



Example of an S-shape curve

This type of forecasting model originated in the study of epidemic diseases during the early part of this century. Today the logistic curve is also used to forecast the development of markets for industrial and consumer goods. The logistic curve has been used to forecast such disparate markets as agricultural tractors in Spain, population records in Britain and telephone penetration in United States.

At the beginning of the PSEAP, only a small proportion of Indians were pursuing post-secondary education. The participation rate increased slowly until 1985 when it was marked by a rapid growth.

It is reasonable to assume that not everybody will attend post-secondary education and consequently, the participation rate will eventually reach a saturation level. For these reason it was felt that the logistic curve would be a good fit to the participation rates series. Appendix I contains technical notes that explain the calculation methods to obtain the logistic curve.

4.2.2.2 Results

The logistic curve has been adjusted to the participation rate series using two different saturation levels (medium and high). To adjust the curve to the observed series it has been assumed that the Indian participation rate will not go over the Canadian participation rates. Consequently, we used the sets of projections of Canadian post-secondary enrolments provided by Statistics Canada (STC) to determine the two saturation levels. For the medium saturation level, the 1998 projected participation rate based on Scenario B of STC projections (.1992) was used. For the high saturation level, the 1998 projected participation rate based on Scenario C of STC projections (.2186) was used.

NOTE: There is a constraint on the choice of the saturation level. Due to computation process, it must always be greater then the largest historical value on which the adjustment is performed. The next graph presents the results. Historical participation rates are plotted along with the fitted participation rates of the two scenarios. The projected participation rates and the corresponding enrolments are presented in Appendix I.





The logistic curve fits well the observed pattern of the participation rate series. Since the logistic curve is a <u>linear</u> regression performed on transformed data it is interesting to look at the coefficient of determination R which gives an idea of the goodness of the fit. For both saturation levels, the R is equal to .94 which means that 94 % of the variance is explained by the model.

The MAD for both saturation levels is equal to .0058. On average using the logistic curve adjustments, the error made when estimating the participation rate is \pm .0058 which is better then the regression on participation rates.

NOTE: The choice of a "good" saturation level does not necessarily lead to a good fit of the data. One should use statistics such as the R or the MAD to guide the choice.

4.2.2.3 Conclusion

The pattern of the logistic curve corresponds to the observed behaviour of the post-secondary participation rates. This approach is also very interesting since a defensible limit, the saturation level, can be put on participation rates. Finally the determination of the saturation level can be (and should be) based both on subject matter expertise and statistical results.

4.2.3 APPROACH 3: DAMPED EXPONENTIAL

4.2.3.1 Definition

For this approach, participation rates have been projected as a damped exponential curve; i.e., participation rates are projected to increase but at a gradually slower and slower rate. The difference between the logistic curve and this one is that for the damped exponential curve, the saturation level cannot be a fixed The saturation level depends on how one plays value. with both "trend" and "weight" factors. The trend factor influences the shape of the curve and the weight factor gives more or less importance to the historical data influencing the rate of damping. Technical notes explaining the damped exponential curve in more details are provided in Appendix J.

4.2.3.2 Results

Three scenarios are proposed: high, medium and low. The rate of damping is progressively increased as one moves from the high to low scenarios. The trend factor was fixed and the three scenarios were obtained by changing the weight factor. The choice of these three scenarios was based on the MAD values, and also on the look of the curves. The need for three distinct scenarios quided the choice of the curves. The high scenario should not be unrealistic (too high) and the low one should be over the 1989 value. Consequently, among the suitable combinations of trend and weight factors, the ones that gave the smallest MAD were chosen. The results obtained with this approach are presented in the next graph. Historical participation rates are plotted along with fitted participation rates of the three scenarios. The projected participation rates and the corresponding enrolments are provided in Appendix J.

participation rates 0.2 0.15 0.1 damped exp. (high) damped exp. (med) 0.05 damped exp. (low) Δ Hist. part. rates D 78 80 82 86 88 90 92 96 98 100 76 84 94 years

Long term forecasting, approach 3 Damped exponential

The MAD values for the three damped exp onential following:

low scenario	:	.0074
medium scenario	:	.0081
high scenario	:	.0086

The damped exponential curves give good results making on average an error between \pm .0074 and \pm .0086.

4.2.3.3 Conclusion

The damped exponential approach gives the flexibility to play with the level of damping of the exponential curve. Thus, one can create as many scenarios as he(she) wants. But having too many scenarios makes the choice even more difficult and can lead to inconsistencies. Finally, it is not possible to identify the weight and trend factors required to produce a specified saturation level. One can only determines the factors associated with a specified saturation level through trial and error.

4.2.4 COMPARISON OF THE LOGISTIC AND THE DAMPED EXPONENTIAL

The logistic and the damped exponential approaches project participation rates under the assumption that they will stop increasing at some point in time. On the next graph, the scenarios of the two approaches are presented together.

Comparison Logistic vs Damped exponential



NOTE: The projections for years 1990, 1991 and 1992 obtained from both the logistic and the damped exponential approach, fall inside the 95 % confidence interval of the regression approach presented for short term forecasting (see section 4.1). The confidence interval is represented on the graph by the thick lines. This observation confirms the use of linear regression combined with the confidence interval for short term forecasting.

In order to compare the results of the logistic and the damped exponential approaches, the MAD's are given for all the scenarios of both approaches in the table 2.

TABLE 2 MAD

Damped exponential Logistic

low scenario	.0074	
medium scenario	.0081	.0058
high scenario	.0086	.0058

Both approaches are close in terms of MAD. The biggest difference, which is .0028, and the smallest which is .0016 correspond respectively to one half and one third of the MAD value of the logistic. The logistic seems therefore to lead to a little bit better results then the damped exponential.

4.3 THE POOL OF POTENTIAL POST-SECONDARY STUDENTS.

Various sets of projections have been produced with the different approaches. But one question still needs to be addressed. Are the projections realistic regarding the pool of potential post-secondary students ?

In year 2000, according to the three long term approaches the number of enrolments could be:

Constant:	19867
Logistic (med):	30325
Logistic (high):	32093
Damped exp. (low):	23663
Damped exp. (med):	22458
Damped exp. (high):	28121

In year 2000, according to 1989 Indian Register projections, there will be 170393 registered Indians aged 18 to 34. Without any regards to the level of education, this number represents the pool of potential post-secondary students. However, if the level of education is taken into account, not all these persons will be gualified to attend postsecondary school.

Generally speaking, the students who attend grade 12 or grade 13, even if they do not graduate from high school are the ones most likely to pursue post-secondary studies.

NOTE: For the purpose of this study grade 12 and grade 13 students are considered to be aged 18.

The Enrolment Projection System (EPS) built for elementary and secondary projections was used to estimate the number of on-reserve students that will attend grade 12 and grade 13 in years 1989 to 1997. Data prior to this date are available through the nominal roll. The student aged 18 in 1984 will be aged 34 in year 2000. The students aged 18 in 1997 will be aged 21 in year 2000. The summation of the onreserve grade 12 and grade 13 students from 1984 to 1997 give a total number of 48850 students in year 2000 aged from 21 to 34.

Elementary & Secondary School data on Indians living off-reserve are not available. In Year 2000 there will be 85539 on-reserve Indians aged 21 to 34 compared to 47175 for the off-reserve. Based on these projections, 57% of the on-reserve Indian population aged 18 years old will have attend grade 12 or grade 13 (48850/85539). If this proportion is applied to the offreserve 18 years old population we obtain an estimate of 26941 off-reserve students who will attend grade 12 or grade The total for both on and off-reserve is equal to 13. 75791.

The total number of potential post-secondary on+off reserve students for year 2000 is in reality greater then 75791 for the following reasons:

- 1) The calculations only covers the ages 21 to 34 meaning that ages 18, 19 and 20 are missing.
- 2) The pool of 75791 represents all the potential students aged 21 to 34 that attended grade 12 or grade 13. This number excludes the persons who have less then a grade 12 and pursue post-secondary studies.
- 3) On average (1984 to 1988), only 20 % of the 18 years old on-reserve registered Indians graduates from high school each year compare to 60% of the 18 years old Canadian S It is expected that this ratio will improve through the years and reach a level comparable to the Canadian students. The number of potential postsecondary students will increase accordingly.
- 4) Furthermore, it is believed that off-reserve students behave differently then on-reserve students regarding high school attendance. Consequently, the proportion of 57% applied earlier may be too low.

On the other hand, this study does not take into account that each year from 1989 to 2000, a certain number of students will graduate from post-secondary studies thus reducing the pool of potential students. Although some students pursue their post-secondary studies to obtain a masters or a PHD. A more sophisticated study should be performed to explore the impact of these factors.

5. CRYSTALLIZATION STAGE, MODEL II

The main purpose of the crystallization stage of model II was to build a forecasting model to project enrolments at the regional level. The main sources of data at the regional level are the Headquarters (HQ) and the Regional Offices (RO'S). The data at the regional level available at Headquarters are incomplete. Consequently, a questionnaire was send to each regional office in order to obtain more detailed information. A study of the data provided by the regional offices has been performed. The data from the RO's have been compared to the HQ data at both regional and national levels.

The results are presented in a document entitled "Résultats de l'exploration des données régionales, Document technique 90-7, AQRS, Octobre 1990". The following lines give a summary of the results of the study. As mentioned earlier, (section 2.3.3) a problem of reconciliation between the HQ and the RO data has been observed. The data from the RO's are considered the ones being the most up to date. Consequently, the quality of regional data available at HQ is questionable. On the other hand, the data provided by the regional offices are incomplete and very different from one region to the other. Due to a lack of good quality data at the regional level, it is not possible to build a regional forecasting model which would be statistically defensible.

However, despite the differences observed at the regional level, HQ and RO's data are comparable at the national level. The enrolments and the participation rates series of both set of data present similar behaviour. The proportion of full-time vs part-time and UCEP vs post-secondary students are also equivalent. Finally, according to HQ and RO's data, the percentage of enrolment in each region is constant since 1986 (see Appendix K). The projections based on HQ data at the national level are considered to reflect projections that would have been obtained using RO's data at the national level.

Crude solution

Until more complete and valid data are available at the regional level, rough estimates of enrolments by region could be derived by prorating the national enrolment figures using the average of the percentages of enrolments observed in the region since 1986 (Appendix K). The Appendix L gives the number of enrolments by region and by approach.

A secondary goal of the Model II stage has been the development of other forecasting methods such as projections of enrolments instead of participation rates and the study of the correlation between grades G12+G13 and post-secondary enrolments. The results of the studies exploring these approaches are presented in Appendix M.

6. CONCLUSION

All the techniques presented for short term and long term forecasting give the user the flexibility to choose an approach that reflects his/her idea of what the future situation will be. Consequently, the user must be careful and analyze each situation separately, looking at all the factors that may contribute to the projections. The choice of an approach should be guided by the knowledge of a situation and by statistical results obtained when fitting a curve. However, the logistic curve seems to give better results then the other approach and also gives the flexibility to decide of a saturation level. And in addition, it is associated with observed patterns of human adaptive behaviour. Therefore this approach should be preferred among the others.

7. PROGRAMMING

The volume side of the Post-Secondary Long Term Costing Model (PS-LTCM) has been "programmed" using LOTUS 123 version 2.2. The volume system is comprised of four LOTUS worksheets. The first worksheet contains the enrolment figures (historical) and the population figures (historical and projections) needed for the calculations. The other three worksheets contain the programs for the regression, the logistic and the damped exponential approaches. The programs were built to be as user-friendly as possible considering the capability of LOTUS 123 version 2.2.

A document entitled "Post-Secondary Long Term Costing Model, Volume System User Guide" describes the steps to operate each of the worksheets. The system produces post-secondary enrolment projections at the national level. Rough estimates at the regional level can be derived using percentages available in Appendix K of this document.

It is assumed that the person using the system has some knowledge of LOTUS 123 and is <u>fully familiar</u> with the methodology of the volume side of the PS-LTCM.

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APPENDIX A

LIST OF CONTACTS

1. ORGANIZATION: Statistics Canada, Division of projection and analysis in education.

Date: February 1990 Contact name: Warren Clark Phone number: 951-1522

- <u>PURPOSE:</u> Obtain data or forecasting model for volume side (and cost)
- ANSWER: Obtained historical and unpublished projections of Canadian enrolment by age and sex 1975/76 to 1998/99.

Discussed the methodology used by STC to project enrolments at the post-secondary level. Basically, the projection are based on participation rates computed by age group.

Obtained the documentation on the methodology for school leavers model.

Received graphics on post-secondary condition in Canada.

Obtained data on transfer from secondary to post-secondary school.

- ACTIONS: None. (M) Clark is available for questions or other requests.
- 2. ORGANIZATION: Employment and Immigration Canada (EIC)

Date: February 1990 Contact name: Wayne Roth Phone number: 953-8266

- <u>PURPOSE</u>: Obtain data or forecasting model for volume side (and cost)
- ANSWER: Obtained documentation on COPS, Canadian occupational Projection System.

ACTIONS: None.

3. ORGANIZATION: Council Ministers of Education Canada (CMEC)

Date: February 1990 Contact name: Mme Nicole Davignon Phone number: (416) 964-2551

- <u>PURPOSE</u>: Obtain data or forecasting model for volume side (and cost)
- ANSWER: CMEC coordinate activities and meetings between ministers. They do not perform any analysis. They are more concern with political aspects of education. When a study is needed the demand is made to the province. Conclusion: better look at education department in each province.

Suggestions: STC Secretariat of state, education division EIC COPS: Occupational Projection System There is a part for education.

NOTE: Data at the national level are not necessarily accepted by the provinces.

ACTIONS: Follow-up on suggestions.

4. ORGANIZATION: Canadian Association of Community Colleges (CACC)

Date: February 1990 Contact name: Mme Micheline Reid Phone number: (416) 489-5925

- <u>PURPOSE</u>: Obtain data or forecasting model for volume side (and cost side).
- ANSWER: Nothing on the volume side. Suggestion: provinces

Cost side contact Susanne Robinson.

ACTIONS: Émile is suppose to follow-up on costs.

5. ORGANIZATION: Association of Universities and Colleges of Canada (AUCC), Section of research and analysis

Date: February 8, 1990 Contact name: Robert Davidson Phone number: 563-1236

<u>PURPOSE</u>: Obtain data or forecasting model for volume side (and cost)

ANSWER: Nothing on cost side. Suggestions: Canadian federation of students Todd Smith, 232-7394 "They often talk about students debts, may be they did some analysis on costs".

Did very little on volume side:

Played with participation rate among age group, sex group etc. using 1986 census. Did project number of doctorates in Canada in year 2000. The model was based on time series analysis and participation rates.

Suggestions: Canadian federation of students STC

ACTIONS: Follow-up on suggestions.

6. ORGANIZATION: Canadian Federation of Students

Date: February 8, 1990 Contact name: Todd Smith Phone number: 232-7394

<u>PURPOSE</u>: Obtain data or forecasting model for volume side (and cost)

ANSWER: Nothing interesting

ACTIONS: None

APPENDIX B

DATA

N

This appendix contains the data used for Model I.

Historical data

					= = = = = = = =	======	=====
Year	Population aged 18-34	Enrol.	Part. rate	e Full time	Part time	C-31	UCEP
= = = = =	=============	=========		========	======	=====:	=====
76 77	78514 82156	2684	0.0342	n/a n/a	n/a	n/a n/a	n/a
78	86210	4148	0.0481	n/a	n/a	n/a	n/a
79	90462	4502	0.0498	n/a	n/a	n/a	n/a
80	94640	4999	0.0528	n/a	n/a	n/a	n/a
81	99100	6156	0.0621	n/a	n/a	n/a	n/a
82	103424	6810	0.0658	n/a	n/a	n/a	n/a
83	108180	8062	0.0745	n/a	n/a	n/a	n/a
84	113096	8567	0.0757	n/a	n/a	n/a	n/a
85	118237	12164	0.1029	9453	1717	446	994
86	128500	14914	0.1161	11533	1663	1284	1718
87	139540	15921	0.1141	12461	1781	2188	1679
88	150678	15572	0.1033	12269	1690	2907	1613
89	158970	18535(*)	0.1166	16195	2340	3818	n/a
90	165570	20786					

NOTE: For years 1985,86,87 and 88, full-time and part-time counts exclude UCEP students. For these years, the total enrolment = full-time + part-time + UCEP

(*) The enrolment figure for 1989 is an estimation.

Medium scenario, Registered Indian Population Projections

=====	
Year	Population
	aged 18-34
=====	
90	165570
91	167306
92	168529
ด์รี	169463
9.0	170212
24	170212
95	170534
96	170602
97	170610
98	170487
99	170438
100	170393

NOTE: Enrolment and population data exclude the NWT region.

APPENDIX C

LIST OF REQUIRED DATA FOR A MORE SOPHISTICATED MODEL

A list of required data has been built based on the client (Finance and Education) need statement prepared for the long term costing model (LTCM) for post-secondary education.

LIST OF REQUIRED DATA

For each student:

Unique identifier

Region number

Band number

Code: on-reserve, off-reserve

Code: full time, part time

Code: bill C31, non bill C31

Code: UCEP, Post-secondary

Type of institution: University, college, etc.

Program: Type of program (math, biology etc.)

Address: Temporary (while at school)

Address: Permanent

Birth date (age)

Allowance category: single living at home with parent single living alone single parent married with unemployed spouse married with employed spouse

Number of dependant(s)

Age of dependent(s)

Status of a student:

New from high school New from UCEP New: other (people going back to school after a certain period of time)

It might be useful to know highest grade attained at school.

NOTE: New means new student in post-secondary.

_Continuing (student re-enroling or continuing) Graduation (year) Dropped out (year)

There must be one or more fields from which we will be able to distinguish between the students who are coming "fresh" from high school or from UCEP program from all the others. It may also become important to identify the students who are going back to school after a certain period of time (working or not). These statistics will be used to measure "survival ratio" between high school, UCEP and post-secondary education. They will also be used to compute entry rates. The number of students graduating each year and dropping out each year is necessary to measure both the graduating and the drop-out rates.

Need number of high school graduates (on and off reserve)

Need number of UCEP graduates

Need registered Indian population data by age

NOTE: The last three pieces of information are not part of an education data base but are needed to project postsecondary enrolments.

Etc.

Wherever possible, numbers should be used instead of characters. Use of uniform coding and definition should be promoted across the regions (example: full time, part time). Furthermore, if application records and student records are kept on a data base, one must be able to link all the applications of a student for a year and consequently avoid double counts. If the post-secondary assistance program eventually needs to know about the financial situation of a student, his(her) spouse and dependents, then relevant pieces of information should be added to the list.

The above list is not exhaustive. It is based on knowledge of data acquired while working on LTCM project. If the objective (subobjectives) of the post-secondary education program, or the client need statements of the LTCM changes, the information required for enrolment projections may also change. Furthermore, Education Branch certainly has additional needs regarding post-secondary data.

MINI STUDIES

The purpose of the mini studies is to perform a descriptive analysis of factors such as C-31, UCEP, full-time and part-time students and also analyze the age distribution based on the 1989/90 database.

1. C-31

The following table contains data on C-31's. As observed, the number of C-31 enrolments increased from 446 in 1985 to 3818 in 1989. However, the corresponding participation rate dropped from about 80 % in 1985 to 21 % in 1986 and seems constant (around 15 %) since 1987. On the other hand, the participation rate of the non-C-31 is about the same (.10) for all the years.

C-31 data

=====		=======================================		
Year	Enrolment	C-31 pop	C-31	Non C-31
	(C-31)	age 18-34	part. rate	part. rate
=====		================		=================
85	446	546 (1)	0.8173	0.0996
86	1284	6158	0.2085	0.1114
87	2188	13329	0.1642	0.1088
88	2907	19824	0.1466	0.0968
89	3818	256 7 9	0.1487	0.1104

NOTE (1): This number has been estimated using BDD number of C-31. The estimation was done based on the proportion of C-31 aged 18-34.

Year	BDD C-31	د = = = = = = = = = = = = = = = = = = =
85 86 87 88 89	1605 17857 17056 54774 68615	0.34 0.36 0.36 0.37
	.34 x 1605	= 546

2. UCEP

The proportion of UCEP students among all the post-secondary enrolments is around 10 % for the years 1985 to 1988. The corresponding data are presented in the next table.

Table 3 : UCEP data

================		=====
Number of	Total	0/0
UCEP	enrolment	
	=======================================	=====
994	12164	.08
1718	14914	.12
1679	15921	.11
1613	15572	.10
	======================================	Number of Total UCEP enrolment 994 12164 1718 14914 1679 15921 1613 15572

NOTE: The number of UCEP students in the 1989/90 database is not available.

3. Full time and part time

The next table contains information about the proportion of full time and part time students among total enrolments for 1985 to 1989. Again, the proportions of full time and part time students stay constant over the years.

Table 4 : Full-time and part-time data

Year Full time % Part time %

85	9453	0.85	1717	0.15
86	11533	0.87	1663	0.13
87	12461	0.87	1781	0.13
88	12269	0.88	1690	0.12
89	16195	0.87	2340	0.13

NOTE: As mentioned earlier, the total number of enrolments for the years 1985 to 1988 = number of full time + part time + UCEP. UCEP data were not split by full time and part time. Consequently, UCEP data were not taken into account to compute the proportion of full time and part time for these years.

4. Age distribution

The data used for this analysis come from the 1989/90 database. The total 16862, corresponds to the number of students for which the age was available. It has been assumed that the missing students (1673) were following the same age distribution then the others.

The next table contains the age distribution of the students along with the corresponding percentages and cumulative percentages. The total number of students is split by full-time and part-time. As observed, the age of the students varies from 17 to 54. 80 % of the total number of students are age between 17 and 34 which is older then what has been observed with the Canadian students (80 % are aged between 17-24, STC). Furthermore, 50 % of the full-time students are aged between 17 and 24. In comparison, 50 % of the part-time students are aged from to 17 to some age between 30 and 34. These observations indicate that the full-time students are younger then the part-time students. It also indicates that overall, the Indian students are older than the Canadian students.

=====		= = = = = =	=======	=========	= = = = :	================		= = = = =	=====
Age	Total	20	% cum	Full time	210	% cum	Part time	240	% cum
=====		=====			====:			* = = = =	*****
$ \begin{array}{r} 17 \\ 18 \\ 19 \\ 20 \\ 21 \\ 22 \\ 23 \\ 24 \\ 25 \\ 26 \\ 27 \\ 28 \\ 29 \\ 30-34 \\ 35-39 \\ 40-44 \\ 45-49 \\ 50-54 \\ \end{array} $	$1112 \\ 366 \\ 903 \\ 1148 \\ 1123 \\ 1033 \\ 943 \\ 882 \\ 814 \\ 731 \\ 642 \\ 561 \\ 590 \\ 2375 \\ 1697 \\ 1055 \\ 535 \\ 352 \\ \end{cases}$.07 .02 .05 .07 .07 .06 .06 .05 .05 .04 .03 .03 .14 .10 .06 .03 .02	.07 .09 .14 .21 .28 .34 .40 .45 .50 .54 .58 .61 .64 .78 .88 .94 .98 1.00	$783 \\ 354 \\ 869 \\ 1105 \\ 1080 \\ 989 \\ 888 \\ 808 \\ 737 \\ 654 \\ 571 \\ 486 \\ 499 \\ 1989 \\ 1357 \\ 834 \\ 394 \\ 263 \\ \end{array}$.05 .02 .06 .08 .07 .07 .06 .06 .04 .04 .03 .03 .14 .09 .06 .03 .02	.05 .07 .13 .21 .29 .36 .42 .49 .54 .58 .62 .65 .68 .82 .91 .97 .98 1.00	$329 \\ 12 \\ 34 \\ 43 \\ 43 \\ 44 \\ 55 \\ 74 \\ 77 \\ 77 \\ 71 \\ 75 \\ 91 \\ 386 \\ 340 \\ 221 \\ 141 \\ 89 $.15 .01 .02 .02 .02 .02 .03 .03 .03 .03 .03 .03 .03 .03 .04 .15 .10 .06 .04	.15 .16 .18 .20 .22 .24 .26 .29 .32 .35 .38 .41 .45 .63 .78 .88 .95 1.00
total	16862	1.		14660			2202		
	34								

33

APPENDIX E

STATISTICS CANADA PROJECTIONS

This Appendix presents a short description of the post-secondary enrolment projections obtained by Statistics Canada.

Three unpublished projections (ABC) of Canadian enrolment by age and by sex to 1998/99 were received from STC. The last historical year is 1988/89 and the first projected year is 1989/90.

The projections are based upon STC population projection #3 which assumes a fertility rate of 1.7 children per woman by 2001, 200,000 annual immigrations by 1995/96 and 80,000 annual emigrations. The enrolment projections are created by applying enrolment rates or participation rates to the population.

Enrolment projections A holds all enrolment rates constant at the last observed value (1988/89) for the entire projected time period. Projection B assumes a continuation of recent observed trends to higher school and post-secondary participation. The exception is male college participation which has recently decreased and further marginal decreases are projected as a continuation of that trend. All enrolment rates are projected as a damped exponential curve (i.e., enrolment rates are projected to increase but at a gradually slower and slower rate). Due to the long nature of these projections and the strong recent increases in enrolment rates , the damped exponential model avoids creating a "shies the limit" type of projection. Projection C assumes a continuation of recent trends as in Projection B but the rate of damping is less acute thereby allowing enrolment rates to increase more rapidly. In addition, male college participation is projected to increase in Projection C.

Two participation rate series were calculated based on STC enrolment projections B and C (total enrolment/population (18-34)). The next graph shows the two series and the following table contains the data.





APPENDIX F

RESULTS: SHORT TERM APPROACH: Linear regression.

Response variable: Participation rate ==> P Predictor variable: Year ==> Y The adjusted model: P = -.4835 + .0068 Y + ewhere e is the error term. $R^2 = .9283$

Graph of residuals.



No real pattern is observed on the graph, the residuals seems randomly distributed around zero. Based on the R value and on the look of the residual graph, we can say that the model fits well the data. The model can thus be used to project values of participation rate.

The following table contains the results of the linear regression

REGRESSION (short term forecasting)

Lower 95 % confidence interval

====	=======================================			==========
Year	Participation rate	Enrolment	Full-time (0.8761)	Part-time (0.1239)
=====	=======================================	===============		
 90 91	0.1165 0.1222	19281	16892 17907	2389
92	0.1279	21550	18880	2670

Regression

	=======================================			
Year	Participation rate	Enrolment	Full-time (0.8761)	Part-time (0.1239)
	=======================================		=======================================	=======
90	0.1265	20952	18356	2596
91	0.1333	22305	19541	2764
92	0.1401	23611	20685	2926

Upper 95 % confidence interval

=====	Participation	Enrolment	Full-time	Part-time
Year	rate		(0.8761)	(0.1239)
90	0.1366	22622	19819	2803
91	0.1445	24171	21176	2995
92	0.1523	25672	22491	3181

Table :

Canadian participation rates _____ Scenario B Scenario C Year _____ 76 0.1219 0.1219 77 0.1238 0.1238 78 0.1223 0.1223 79 0.1225 0.1225 --80 0.1250 0.1250 81 0.1274 0.1274 82 0.1343 0.1343 0.1562 83 0.1562 84 0.1594 0.1594 85 0.1630 0.1630 0.1654 86 0.1654 87 0.1690 0.1690 _ _ 88 0.1713 0.1722 Projections 89 0.1743 0.1781 0.1779 0.1837 90 91 0.1804 0.1880 92 0.1829 0.1924 93 0.1852 0.1964 0.2005 94 0.1876 95 0.1901 0.2047 0.2093 96 0.1931 97 0.1960 0.2138 98 0.1992 0.2186

Data on population and enrolments (historical and projections) by age and by sex are available upon request.

COMPARISON: Linear regression with and without C-31

In order to measure the impact of the C-31 student on the participation rate, two linear regression lines were fitted to the data. One which includes C-31 students in the calculations and the other that does not.

The data used to compute the regression without the C-31's are presented in the next table.

Data without C-31

Year	Population aged 18-34	Enrolment without C-31	Participation rate without C-31
76 77 78 79 80 81 82 83 84 85 86 87 88	78514 82156 86210 90462 94640 99100 103424 108180 113096 117691 122342 126211 130854	2684 3599 4148 4502 4999 6156 6810 8062 8567 11718 13630 13733 12665	$\begin{array}{c} 0.0342\\ 0.0438\\ 0.0481\\ 0.0498\\ 0.0528\\ 0.0621\\ 0.0658\\ 0.0745\\ 0.0757\\ 0.0996\\ 0.1114\\ 0.1088\\ 0.0968\end{array}$
89 90 91 92	$133291 \\ 134296 \\ 136124 \\ 137525$	14717	0.1104

The model :

Response variable : participation rate without C-31 ==> PWC-31 Predictor variable : Year ==> Y

The adjusted model :

PWC-31 = -.4401 + .0062 Y + e

Where e is the error term

 $R^2 = .9273$

The next graph shows the two regression lines along with their respective 95 % confidence interval.



Comparison linear regressions with and without C31

As observed, the two lines are within both sets of interval. Conclusion: the two regression lines are not significantly different from each other and therefore C-31 students do not have a significative impact on the participation rate.

APPENDIX H

LONG TERM FORECASTING APPROACH 1: CONSTANT

.

The results of this approach are the following:

CONSTANT PARTICIPATION RATE value 1989 = .1166

	=================		==================
Participation rate	Enrolment	Full-time (0.8761)	Part-time (0.1239)
0.1166	19305	16913	2392
0.1166	19507	17090	2417
0.1166	19650	17215	2435
0.1166	19758	17310	2448
0.1166	19846	17387	2459
0.1166	19883	17419	2464
0.1166	19891	17426	2465
0.1166	19892	17427	2465
0.1166	19878	17415	2463
0.1166	19872	17410	2462
0.1166	19867	17405	2462
	Participation rate 0.1166 0.1166 0.1166 0.1166 0.1166 0.1166 0.1166 0.1166 0.1166 0.1166 0.1166 0.1166 0.1166 0.1166 0.1166	Participation Enrolment rate 0.1166 19305 0.1166 19507 0.1166 19650 0.1166 19758 0.1166 19846 0.1166 19883 0.1166 19891 0.1166 19892 0.1166 19878 0.1166 19872 0.1166 19867	ParticipationEnrolmentFull-time (0.8761)0.116619305169130.116619507170900.116619650172150.116619758173100.116619846173870.116619891174260.116619892174270.116619878174150.116619878174150.11661987217405

APPENDIX I

LONG TERM FORECASTING APPROACH 2: LOGISTIC CURVE

1. TECHNICAL NOTES

The logistic curve is obtained by performing a linear regression on transformed data.

"Notation: y_i: year, i = 1976 ,..., 1989
p_i: participation rate, i = 1976 ,..., 1989
 (total enrolment ÷ population 18-34)
t_i: transformed data = ln((k/p_i)-1)
k: saturation level

1.1 Linear regression:

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T: response variable

Y: predictor variable

Model

T = \alpha + \betaY + e

where \alpha: constant

\beta: slope

e: error term

1.2 Projections: year 1990 ,..., 2000:
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 $t_{i} = \alpha + \beta y_{i}$

where i = 1990 ,..., 2000

1.3 Transformation of t_into p_ (estimated participation rate)

 $p_i = k / (exp(t_i) + 1)$ where i = 1976 ,..., 2000

2. RESULTS

The logistic curve has been adjusted to the participation rates series using two different saturation levels: medium and high. The following table contains the results.

LOGISTIC CURVE

Medium scenario : saturation level = .1992

Year	Participation rate	Enrolment	Full-time (0.8761)	Part-time (0.1239)
90	0.1289	21336	18692	2644
91	0.1356	22690	19878	2812
92	0.1420	23934	20968	2966
93 94	0.1480	25082	21974 22902	3239
95	0.1587	27065	23711	3354
96	0.1634	27875	24421	3454
97	0.1676 0.1715	28602	25058	3544
99 99	0.1749	29811	26117	3694
100	0.1780	30325	26567	3758

High scenario : saturation level = .2186

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Year	Participation rate	Enrolment	Full-time (0.8761)	Part-time (0.1239)
90	0.1304	21583	18908	2675
91	0.1378	23057	20200	-285 7
92	0.1450	24435	21407	3028
93	0.1518	25 7 31	22542	3189
94	0.1583	26948	23609	3339
95	0.1644	28034	24560	3474
. 96	0.1700	29009	25414	3595
97	0.1753	29900	26195	3705
98	0.1800	30694	26890	3804
99	0.1844	31428	2 7 534	3894
100	0.1883	32093	28116	3977

APPENDIX J

LONG TERM FORECASTING APPROACH 3: DAMPED EXPONENTIAL

1. TECHNICAL NOTES

The purpose of this appendix is to explain the theory behind the damped exponential.

With the damped exponential, participation rates are projected to increase but at a slower and slower rate. The shape of the curve and the rate of damping are determined by the trend and the weight factors.

The trend factor influences the shape of the curve. The next graph shows three exponential curves. Each of the curves were built using a different trend (t) factor.



Variation of the trend factor

If t > 1, then the shape of the curve is exponential i.e. the participation rates are increasing at a faster and faster rate. When t = 1 then the curve is linear i.e. the increasing rate is constant. Finally, if t < 1 then the curve is a damped exponential.

The damped exponential computations can be seen as if a moving weighted average were calculated using historical data.

Example of a moving weighted average :

Step 1

Data: Year 76 Year 77 Year 78 Year 79 Weights: Wa < Wb < Wc < Wd

Year 80 = weighted average of Year 76 to Year 79

Step 2

Data: Year 76 Year 77 Year 78 Year 79 Year 80 Weights: Wa' < Wb' < Wc' < Wd' < We'

Year 81 = weighted average of Year 76 to Year 80

For the damped exponential, the weight are determined according to a function that will give more or less importance to the most recent observations. This function depends on α , the weight factor.

The value of the weight factor (α) can vary from 0 to 1. A Large value of α will give relatively more important weights to recent data then a small value of α . In order to visualize this concept the next graph presents two examples of weights obtained using different values of α . The X axis shows decreasing years and the Y axis the corresponding weight.



Variation of the weight factor

With $\alpha = .7$ the difference between the weights of the recent and the weights of the "old" years is large compare to the difference when $\alpha = .2$. When a small α is used, the resulting exponential curve is more damped then when a large α is used.

Many scenarios can be created by varying the trend and the weight factors. However, as stated before one should be vary careful while manipulating and using these scenarios. They are not all suitable, and if used incorrectly, inconsistencies can results.

2. RESULTS

Three scenarios (low, medium and high) have been adjusted to the participation rate series. The results are the following:

DAMPED EXPONENTIAL

Low scenario : trend = .8, weight = .8

Year	Participation rate	Enrolment	Full time (0.8761)	Part time (0.1239)
90	0.1209	20019	17538	2481
91	0.1249	20902	18312	2590
92	0.1282	21598	18922	2676
93	0.1307	22154	19409	2745
94	0.1328	22602	19801	2801
95	0.1344	22926	20085	2841
96	0.1358	23160	20290	2870
97	0.1368	23341	20449	2892
98	0.1377	23468	20560	2908
99	0.1383	23577	20655	2922
100	0.1389	23663	20731	2932

Medium scenario : trend = .8, weight = .9

Year	Participation rate	Enrolment	Full time (0.8761)	Part time (0.1239)
90	0.1238	20505	17964	2541
91	0.1298	21717	19026	2691
92	0.1346	22679	19869	2810
93	0.1384	23451	20545	2906
94	0.1414	24074	21091	2983
95	0.1439	24536	21496	3040
96	0.1458	24879	21796	3083
97	0.1474	25146	22030	3116
98	0.1486	25341	22201	3140
99	0.1496	25504	22344	3160
100	0.1504	25634	22458	3176

niqui scenario : crenuv, weight - i	Hiqh	scenario	:	trend	=	.8,	weight	÷	1
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Year	Participation rate	Enrolment	Full time (0.8761)	Part time (0.1239)
90	0.1272	21059	18449	2610
91	0.1357	22699	19886	2813
92	0.1425	24008	21033	2975
93	0.1479	25060	21955	3105
94	0.1522	25910	22699	3211
95	0.1557	26551	23261	3290
96	0.1585	27036	23686	3350
97	0.1607	27416	24019	3397
98	0.1625	27700	24267	3433
99	0.1639	27934	24473	3461
100	0.1650	28121	24636	3485

APPENDIX K

PERCENTAGE OF ENROLMENTS BY REGION

Average of 1985-1989 (Data from Headquarters)

Region

Atlantic	4.84%
Québec	10.98%
Ontario	34.17%
Manitoba	10.74%
Saskatchewan	11.52%
Alberta	12.63%
British Columbia	14.55%
Yukon	0.57%

These proportions can be used to prorate national projections to obtain crude estimates of enrolments by region.

APPENDIX L

NUMBER OF ENROLMENTS BY REGION, BY APPROACH

REGRESSION

	Total en	rolments	5						
	National	ATL	QC	ONT	MAN	SASK	ALB	С.В.	YUKON
		0.0484	0.1098	0.3417	0.1074	0.1152	0.1263	0.1455	0.0057
90 91 92	20952 22305 23611	$\begin{array}{c}1015\\1080\\1144\end{array}$	2300 2448 2591	7160 7622 8069	2250 2395 2535	2413 2569 2719	2647 2818 2983	3049 3246 3436	119 127 134
	Full time	e enrolm	ents (.)	8761)					
	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
90 91 92	$18356 \\ 19541 \\ 20685$	889 947 1002	$2015 \\ 2145 \\ 2270$	6273 6678 7069	1971 2098 2221	$2114 \\ 2250 \\ 2382$	$2319 \\ 2469 \\ 2613$	$2671 \\ 2844 \\ 3010$	104 111 117
	Part time	e enrolm	ents (.)	1239)					
	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
90 91 92	2596 2764 2926	$\begin{array}{c}126\\134\\142\end{array}$	$285 \\ 303 \\ 321$	$887 \\ 945 \\ 1000$	279 297 314	299 318 337	328 349 370	378 402 426	15 16 17

The percentages of enrolments by regions come from Appendix K.

The percentages of full time and part time enrolments are based on a national average of historical data (1985 to 1989). The average was computed taking into account that 95% of the UCEP students are enroled in full time study.

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REGRESSION Lower 95% confidence interval

Total enrolments (lower 95% C.I.)

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90 91 92	$ \begin{array}{r} 19281 \\ 20440 \\ 21550 \end{array} $	934 990 1044	2116 2243 2365	6589 6985 7364	$2070 \\ 2195 \\ 2314$	2221 2354 2482	2436 2582 2722	2806 2974 3136	$\begin{array}{c}109\\116\\122\end{array}$	
	 Full time	enrolm	ents (lo	wer 95%	C.I.) (.	8761)				
90 91 92	16892 17907 18880	818 867 915	1854 1965 2072	5773 6119 6452	1814 1923 2027	$1945 \\ 2062 \\ 2174$	2134 2262 2385	2458 2606 2747	96 102 10 7	
	Part time enrolments (lower 95% C.I.) (.1239)									

N	ational	ATL	QC	ONT	MAN	SASK	ALB	С.В.	YUKON
90	2389	116	262	816	257	275	302	348	14
91 92	2533 2670	$123 \\ 129$	278	912	287	307	320	389	$14 \\ 15$

REGRESSION Upper 95% confidence interval

Total enrolments (upper 95% C.I.)

	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
		0.0484	0.1098	0.3417	0.1074	0.1152	0.1263	0.1455	0.0057
90 91 92	22622 2 4171 25672	$1096 \\ 1171 \\ 1244$	2483 2653 2818	7731 8260 8773	2429 2596 2757	2605 2784 2957	2858 3054 3243	3292 3517 3736	128 137 146

Full time enrolments (upper 95% C.I.) (.8761)

	National	ATL	QC	ONT	MAN	SASK	ALB	С.В.	YUKON
90 91 92	$19819 \\ 21176 \\ 22491$	960 1026 1089	$2175 \\ 2324 \\ 2469$	6773 7236 7686	$2128 \\ 2274 \\ 2415$	2282 2439 2590	$2504 \\ 2675 \\ 2841$	2884 3082 32 7 3	112 120 128

Part time enrolments (upper 95% C.1.) (.1239)

N	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
90	2803	136	308	958	301	323	354	408	16
91	2995	145	329	1023	322	345	378	436	17
92	3181	154	349	1087	342	366	402	463	18

CONSTANT PARTICIPATION RATE

Total enrolments

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	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
		0.0484	0.1098	0.3417	0.1074	0.1152	0.1263	0.1455	0.0057
90 91 92 93 94 95 96 97 98 99 100	19305 19507 19650 19758 19846 19883 19891 19892 19878 19872 19867	935 945 952 961 963 964 963 963 963 962	2119 2141 2157 2169 2178 2182 2183 2183 2183 2182 2181 2181	6597 6666 6715 6752 6782 6795 6797 6798 6793 6791 6789	$\begin{array}{c} 2073 \\ 2095 \\ 2110 \\ 2122 \\ 2131 \\ 2135 \\ 2136 \\ 2136 \\ 2135 \\ 2134 \\ 2133 \end{array}$	2223 2247 2263 2275 2286 2290 2291 2291 2289 2289 2289	$\begin{array}{r} 2439 \\ 2464 \\ 2482 \\ 2496 \\ 2507 \\ 2512 \\ 2513 \\ 2513 \\ 2511 \\ 2510 \\ 2510 \end{array}$	2809 2839 2859 2875 2888 2893 2895 2895 2893 2892 2891	110 111 112 112 113 113 113 113 113 113 113
	Full time	e enrolm	nents (.8	3 7 61)					
	National	ATL	QC	ONT	MAN	SASK	ALB	С.В.	YUKON
90 91 92 93 94 95 96 97 98 99 100	16913 17090 17215 17310 17387 17419 17426 17427 17415 17410 17405	819 828 834 842 844 844 844 844 843 843	$1856 \\1876 \\1889 \\1900 \\1908 \\1912 \\1913 \\1913 \\1911 \\1911 \\1910$	5780 5840 5883 5915 5942 5953 5955 5955 5951 5950 5948	1816 1835 1849 1859 1867 1870 1871 1871 1871 1870 1869 1869	$1948 \\ 1968 \\ 1983 \\ 1994 \\ 2002 \\ 2006 \\ 2007 \\ 2007 \\ 2006 \\ 2005 \\ 2004 $	2137 2159 2175 2187 2197 2201 2201 2202 2200 2199 2199	$\begin{array}{r} 2461 \\ 2487 \\ 2505 \\ 2519 \\ 2530 \\ 2535 \\ 2536 \\ 2536 \\ 2536 \\ 2534 \\ 2534 \\ 2533 \end{array}$	96 97 98 99 99 99 99 99 99
	Part time	e enrolm	nents (,	1239)					
	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
90 91 92 93 94 95 96 97 98 99 100	$\begin{array}{r} 2 3 9 2 \\ 2 4 1 7 \\ 2 4 3 5 \\ 2 4 4 8 \\ 2 4 5 9 \\ 2 4 6 4 \\ 2 4 6 5 \\ 2 4 6 5 \\ 2 4 6 5 \\ 2 4 6 3 \\ 2 4 6 2 \\ 2 4 6 2 \\ 2 4 6 2 \end{array}$	116 117 118 119 119 119 119 119 119 119 119	263 265 267 269 270 270 271 271 270 270 270 270	817 826 832 837 840 842 842 842 842 841 841	257 260 261 263 264 265 265 265 264 264 264 264	275 278 280 282 283 284 284 284 284 284 284 284	302 305 308 309 311 311 311 311 311 311 311 311 311 311 311	348 352 354 356 358 359 359 359 358 358 358 358	14 14 14 14 14 14 14 14 14 14 14

LOGISTIC CURVE High scenario

Total enrolments

	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
		0.0484	0.1098	0.3417	0.1074	0.1152	0.1263	0.1455	0.0057
90 91 93 93 95 95	21583230572443525731269482803429009	$1045 \\ 1117 \\ 1184 \\ 1246 \\ 1305 \\ 1358 \\ 1405$	2369 2531 2682 2824 2958 3077 3184	7376 7879 8350 8793 9209 9580 9913	2318 2476 2624 2763 2894 3010 3115	2486 2655 2814 2963 3103 3229 3341	2727 2913 3087 3251 3404 3542 3665	3141335535563744392140804221	122 131 139 146 153 159 165
97 98 99	29900 30694 31428 22002	1448 1487 1522	3282 3369 3449 2522	$ \begin{array}{r} 10218 \\ 10489 \\ 10740 \\ 10067 \end{array} $	3211 3296 3375	3443 3535 3619 2606	3777 3878 3970 4054	4351 4467 4573	170 174 178

Full time enrolments (.8761)

	National	ATL	Qc	ONT	MAN	SASK	ALB	C.B.	YUKON
90	18908	916	2075	6461	2030	2178	2389	2751	107
91	20200	978	2217	6903	2169	2326	2552	2940	115
92	21407	1037	2350	7315	2299	2465	2704	3115	121
93	22542	1092	2474	7703	2421	2596	2848	3280	128
94	23609	1144	2591	8068	2535	2719	2983	3436	134
95	24560	1190	2696	8393	263 7	2828	3103	3574	139
96	25414	1231	2789	8685	2729	2927	3211	3698	144
97	26195	1269	2875	8952	2813	3017	3309	3812	149
98	26890	1303	2951	9189	2887	3097	3397	3913	153
99	27534	1334	3022	9409	2957	3171	3478	4007	156
100	28116	1362	3086	9608	3019	3238	3552	4091	160

Part time enrolments (.1239)

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	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
90	2675	130	294	914	287	308	338	389	15
91	2857	138	314	976	307	329	361	416	16
92	3028	147	332	1035	325	349	383	441	17
93	3189	154	350	1090	342	367	403	464	18
94	3339	162	366	1141	359	385	422	486	19
95	3474	168	381	118 7	3 7 3	400	439	506	20
96	3595	174	395	1229	386	414	454	523	20
97	3705	179	407	1266	398	427	468	539	21
98	3804	184	418	1300	408	438	481	554	22
99	3894	189	427	1331	418	448	492	567	22
100	3977	193	437	1359	427	458	502	579	23

LOGISTIC CURVE Medium Scenario

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	National	ATL	QC	ONT	MAN	SASK	ALB	С.В.	YUKON
		0.0484	0.1098	0.3417	0.1074	0.1152	0.1263	0.1455	0.0057
90 91	$21336 \\ 22690$	1033 1099	$\begin{array}{c} 2342\\ 2490\end{array}$	7 291 7 754	2291 2436	$\begin{array}{c} 2457\\ 2613\end{array}$	2695 2866	3105 3302	$\begin{array}{c}121\\129\end{array}$
92	23934	1159	2627	8179	2570	2756	3024	3483	136
93	26141	1215	2869	8933	2893	3011	3302	3804	$142 \\ 148$
95 96	27065 27875	$\begin{array}{c}1311\\1350\end{array}$	2971 3059	9249 9526	2906 2993	$\begin{array}{c} 3117\\ 3210 \end{array}$	$3419 \\ 3521$	3939 4056	$\begin{array}{r}154\\158\end{array}$
97	28602	1385	3139	9774	3071	3294 3367	3613	4162 4254	162 166
99	29234	1410	3272	10187	3201	3433	3766	4338	169
100	30325	1469	3328	T0363	3256	3492	3831	4413	$\pm 1/2$

Full time enrolments (.8761)

	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
90	18692	905	2052	6388	2007	2153	2361	2720	106
91	19878	963	2182	6793	2135	2289	2511	2893	113
92	20968	1016	2301	7 165	2252	2415	2649	3051	119
93	21974	1064	2412	7509	2360	2531	2776	3198	125
94	22902	1109	2514	7826	2459	2638	2893	3333	130
95	23711	1149	2602	8103	2546	2731	2995	3450	135
96	24421	1183	2680	8345	2622	2812	3085	3554	139
97	25058	1214	2750	8563	2691	2886	3166	3646	142
98	25611	1241	2811	8752	2750	2950	3235	3727	145
- 99	26117	1265	2867	8925	2804	3008	3299	3801	148
100	26567	1287	2916	9079	2853	3060	3356	3866	151

Part time enrolments (.1239)

	National	ATL	QC .	ONT	MAN	SASK	ALB	С.В.	YUKON
90	2644	128	290	904	284	304	334	385	15
91	2812	136	309	961	302	324	355	409	16
92	2966	144	326	1014	318	342	375	432	17
93	3108	151	341	1062	334	358	393	452	18
94	3239	157	356	1107	348	3 7 3	409	471	18
95	3354	162	368	1146	360	386	424	488	19
96	3454	167	379	1180	371	398	436	503	20
97	3544	172	389	1211	381	408	448	516	20
98	3623	175	398	1238	389	417	458	52 7	21
99	3694	179	405	1262	39 7	425	467	538	21
100	3758	182	412	1284	404	433	4 7 5	547	21

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DAMPED EXPONENTIAL High scenario

Total enrolments

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	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
		0.0484	0.1098	0.3417	0.1074	0.1152	0.1263	0.1455	0.0057
90 91 92 93 94 95	21059 22699 24008 25060 25910 26551	$1020 \\ 1100 \\ 1163 \\ 1214 \\ 1255 \\ 1286$	2311 2491 2635 2751 2844 2914	7196 7757 8204 8564 8854 9073	2261 2437 2578 2691 2782 2851	2425 2614 2765 2886 2984 3058	2660 2868 3033 3166 3273 3354	3065 3303 3494 3647 3770 3864	120 129 136 142 147 151
96 97 98	27036 27416 27700	$1310 \\ 1328 \\ 1342$	296 7 3009 3040	9239 9369 9466	2903 2944 29 7 4	3114 3157 3190	$3415 \\ 3463 \\ 3499$	$3934 \\ 3990 \\ 4031$	153 156 157
99 100	$27934 \\ 28121$	$\begin{array}{c}1353\\1362\end{array}$	3066 3086	$9546 \\ 9610$	$\begin{array}{c} 3000\\ 3020\end{array}$	321 7 3239	3529 3553	$\begin{array}{c} 4065 \\ 4092 \end{array}$	$\begin{array}{c} 159 \\ 160 \end{array}$

Full time enrolments (.8761)

National	ATL	QC	ONT	MAN	SASK	ALB	С.В.	YUKON
18449	894	2025	6305	1981	2125	2331	2685	105
19886	963	2183	6796	2135	2290	2512	2894	113
21033	1019	2309	7188	2259	2422	2657	3061	119
21955	1063	2410	7503	2358	2528	2774	3195	125
22699	1100	2491	7757	243 7	2614	2868	3303	129
23261	1127	2553	7949	2498	2679	2939	3385	132
23686	1147	2600	8094	2543	2728	2992	3447	134
24019	1163	2636	8208	2579	2766	3034	3495	136
24267	1175	2663	8293	2606	2795	3066	3531	138
24473	1185	2686	8363	2628	2818	3092	3561	139
24636	1193	2704	8419	2645	2837	3112	3585	140
	National 18449 19886 21033 21955 22699 23261 23686 24019 24267 24473 24636	NationalATL1844989419886963210331019219551063226991100232611127236861147240191163242671175244731185246361193	NationalATLQc184498942025198869632183210331019230921955106324102269911002491232611127255323686114726002401911632636242671175266324473118526862463611932704	NationalATLQcONT18449894202563051988696321836796210331019230971882195510632410750322699110024917757232611127255379492368611472600809424019116326368208242671175266382932447311852686836324636119327048419	NationalATLQcONTMAN1844989420256305198119886963218367962135210331019230971882259219551063241075032358226991100249177572437232611127255379492498236861147260080942543240191163263682082579242671175266382932606244731185268683632628246361193270484192645	NationalATLQcONTMANSASK18449894202563051981212519886963218367962135229021033101923097188225924222195510632410750323582528226991100249177572437261423686114726008094254327282401911632636820825792766242671175266382932606279524473118526868363262828182463611932704841926452837	NationalATLQcONTMANSASKALB18449894202563051981212523311988696321836796213522902512210331019230971882259242226572195510632410750323582528277422699110024917757243726142868232611127255379492498267929392368611472600809425432728299224019116326368208257927663034242671175266382932606279530662447311852686836326282818309224636119327048419264528373112	NationalATLQcONTMANSASKALBC.B.1844989420256305198121252331268519886963218367962135229025122894210331019230971882259242226573061219551063241075032358252827743195226991100249177572437261428683303232611127255379492498267929393855236861147260080942543272829923447240191163263682082579276630343495242671175266382932606279530663531244731185268683632628281830923561246361193270484192645283731123585

Part time enrolments (.1239)

	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
90	2610	126	286	892	280	301	330	380	15
91	2813	136	309	961	302	324	355	409	16
92	2975	144	327	1017	319	343	376	433	17
93	3105	150	341	1061	333	358	392	452	18
94	3211	156	352	1097	345	370	406	467	1.8
95	3290	159	361	1124	353	379	416	479	19
96	3350	162	368	1145	360	386	423	487	19
97	339 7	165	373	1161	365	391	429	494	19
98	3433	166	377	1173	369	395	434	500	19
99	3461	168	380	1183	372	399	437	504	20
100	3485	169	383	1191	374	401	440	507	20

DAMPED EXPONENTIAL Medium scenario

Total enrolments

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	National	ATL	QC	ON'T	MAN	SASK	ALB	С.В.	YUKON
		0.0484	0.1098	0.3417	0.1074	0.1152	0.1263	0.1455	0.0057
90 91 92 93 94 95 96 97 98 99 100	$\begin{array}{c} 20505\\ 21717\\ 22679\\ 23451\\ 24074\\ 24536\\ 24879\\ 25146\\ 25341\\ 25504\\ 25634 \end{array}$	$993 \\ 1052 \\ 1099 \\ 1136 \\ 1166 \\ 1189 \\ 1205 \\ 1218 \\ 1227 \\ 1235 \\ 1242$	$2251 \\ 2384 \\ 2489 \\ 2574 \\ 2642 \\ 2693 \\ 2731 \\ 2760 \\ 2781 \\ 2799 \\ 2814$	7007 7421 7750 8014 8227 8385 8502 8593 8660 8715 8760	2202 2332 2435 2518 2585 2635 2672 2700 2721 2739 2753	2361 2501 2612 2701 2773 2826 2865 2896 2918 2937 2952	$\begin{array}{c} 2590 \\ 2744 \\ 2865 \\ 2963 \\ 3041 \\ 3100 \\ 3143 \\ 3177 \\ 3201 \\ 3222 \\ 3238 \end{array}$	2984 3160 3300 3413 3503 3570 3620 3659 3688 3711 3730	$ \begin{array}{r} 116 \\ 123 \\ 129 \\ 133 \\ 137 \\ 139 \\ 141 \\ 144 \\ 144 \\ 145 \\ 145 \\ 145 \\ \end{array} $
	Full time	e enrolm	nents (.8	3761)					
	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON

National ATL Qс ONT MAN SASK ALB 21496 2359 2308 2476 2716

95	21496	1041	2359	7346	2308	2476	2716	3128	122
96	21796	1056	2392	7448	2340	2510	2754	3172	124
97	22030	1067	2418	7528	2366	2537	2783	3206	125
98	22201	1075	2437	7587	2384	2557	2805	3231	126
99	22344	1082	2452	7636	2399	2573	2823	3252	127
100	22458	1088	2465	7675	2412	2586	2837	3268	127

Part time enrolments (.1239)

N	lational	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
90	2541	123	279	868	273	293	321	370	14
91	2691	130	295	920	289	310	340	392	15
92	2810	136	308	960	302	324	355	409	16
93	2906	141	319	993	312	335	367	423	16
94	2983	144	327	1019	320	344	377	434	17
95	3040	147	334	1039	326	350	384	442	17
96	3083	149	338	1054	331	355	389	449	17
97	3116	151	342	1065	335	359	394	453	18
98	3140	152	345	1073	337	362	397	457	18
99	3160	153	347	1080	339	364	399	460	18
100	3176	154	349	1085	341	366	401	462	18

DAMPED EXPONENTIAL Low scenario

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Total enrolments

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	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
		0.0484	0.1098	0.3417	0.1074	0.1152	0.1263	0.1455	0.0057
90 91 92 93 94 95 96 97	$\begin{array}{r} 20019\\ 20902\\ 21598\\ 22154\\ 22602\\ 22926\\ 23160\\ 23341\\ \end{array}$	970 1012 1046 1073 1095 1111 1122 1131	21972294237124322481251625422562	6841 7143 7381 7571 7724 7835 7914 7976	$2150 \\ 2244 \\ 2319 \\ 2379 \\ 2427 \\ 2462 \\ 2487 \\ 2506$	$\begin{array}{r} 2306 \\ 2407 \\ 2487 \\ 2551 \\ 2603 \\ 2640 \\ 2667 \\ 2688 \\ 2688 \\ \end{array}$	2529 2641 2728 2799 2855 2896 2926 2949	2913 3042 3143 3224 3289 3336 3370 3397	114 119 123 126 128 130 131 132
98 99 100	23468 23577 23663	$\begin{array}{c}1137\\1142\\1146\end{array}$	2576 2588 2597	8020 8057 8086	$2520 \\ 2532 \\ 2541$	2703 2715 2725	2965 2979 2989	$3415 \\ 3431 \\ 3443$	$133 \\ 134 \\ 134$

Full time enrolments (.8761)

	National	ATL	Qc	ONT	MAN	SASK	ALB	С.В.	YUKON
90	17538	850	1925	5993	1883	2020	2216	2552	100
91	18312	887	2010	6258	1966	2109	2313	2665	104
92	18922	917	2077	6466	2032	2179	2390	2754	107
93	19409	940	2130	6633	2084	2235	2452	2824	110
94	19801	959	2173	6767	2126	2280	2501	2881	112
95	20085	973	2204	6864	2157	2313	2537	2923	114
96	20290	983	2227	6934	2179	2337	2563	2953	115
97	20449	991	2244	6988	2196	2355	2583	2976	116
98	20560	996	2257	7026	2208	2368	2597	2992	117
99	20655	1001	2267	7058	2218	2379	2609	3006	117
100	20731	1004	2275	7084	2226	2388	2619	3017	118

Part time enrolments (.1239)

	National	ATL	Qc .	ONT	MAN	SASK	ALB	С.В.	YUKON
90	2481	120	272	848	266	286	313	361	14
91	2590	125	284	885	278	298	327	377	15
92	2676	130	294	914	287	308	338	389	15
93	2745	133	301	938	295	316	347	399	16
94	2801	136	307	957	301	323	354	408	16
95	2841	138	312	971	305	327	359	413	16
96	2870	139	315	981	308	331	363	418	16
97	2892	140	317	988	311	333	365	421	16
98	2908	141	319	994	312	335	367	423	17
99	2922	142	321	999	314	337	369	425	17
100	2932	142	322	1002	315	338	370	427	17

APPENDIX M

RESULTS OF MODEL II STUDIES

1. Projections based on enrolments

In Model I, projections of enrolments based on the participation rates series have been computed using various approaches. The same approaches were used to compute projections of enrolments based on the enrolments series.

The regression based on enrolments gave results that are lower then the regression based on the participation rates. This is due to the fact that the population is growing more rapidly then the post-secondary enrolments. On the other hand, the logistic and the damped exponential approaches gave similar results. However, the saturation levels for the logistic curve are not easy to determine. The saturation level were computed by multiplying the saturation level based on participation rates (.2186 and .1992) by the corresponding (1998) Indian population (Canada, excluding NWT, age 18 to 34). The population component was, then, taken into account. This may have an impact on the fact that the results are similar for the logistic curve.

In Model I the projections of enrolments are based on both the enrolments and the population data. The participation rate is a variable which can be compared between two populations (eg. Canadians and Indians). It is believed that the use of more then one variable gives a stronger model.

2. Correlation between grade 12 + grade 13 and post-secondary enrolments

High school students enroled in grade 12 and grade 13 are one of the main sources for potential post-secondary students even if they do not graduate from high school. A study was conducted on the correlation between these two variables. Only on-reserve data were available to perform this study. On-reserve grade 12 and grade 13 enrolments were compared to enrolments for all indian Post-secondary over the years

Students enroled in high school in year Y were considered eligible for post-secondary in year Y+1. The correlation was computed between high school students of year Y and postsecondary enrolments of year Y+1 The following table contains the post-secondary enrolments (from 1977 to 1989) and the number of on-reserve students that were enroled in grade 12 and grade 13 (from 1976 to 1988).

Years	Post-secondary enrolments	Grade 12 + Grade 13 On-reserve	Years
77	3599	1182	76
78	4148	1483	77
79	4502	1543	78
80	4999	1638	79
81	6156	1776	80
82	6810	1838	81
83	8062	2466	82
84	8567	2714	8.3
85	12164	2629	84
86	14914	2812	85
87	15921	3056	86
88	15572	3151	87
89	18535	3404	88

The coefficient of correlation is equal to .8161. Before drawing any conclusions, the following graphier should be considered.





The graphic presents the post-secondary enrolments from 1977 to 1989 and the number of grade 12 + grade 13 from 1976 to 1988. The two curves do not have the same trends. The post-secondary enrolments seems to grow faster then the number of grade 12 and grade 13 students. Furthermore, the "bump observed in the postsecondary curve does not appear in the high school curve.

Based on the above observations, it has been concluded that the relationship that exists between the two variable under study is not strong enough to base a forecasting model on it. However, it gives an idea on how the on-reserve grade 12 and grade 13 enrolments have evolved over the years compared to post-secondary enrolments.