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## POST-SECONDARY <br> LONG-TERM COSTING MODEL

## DOCUMENTATION OF THE VOLUFE SIDE

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The Long Term Costing Model for Post-Secondary Education (LTCMPSE) 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 yodel 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 Research in Higher Education, Canadian Journal of Higher Education, Lotus, 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 contact.ed. 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, sone 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 natjonal level and sometimes regional level for some or all of the following basic data elements: total enrolments, C-3l, 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 tota] enrolments are available at the national and regional levels.

Data for 1985/86 to 1987/88 were retrieved fron 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.

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 fron 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 $\mathrm{C}-31$ students, UCEP etc. are presented in Appendix B.

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

## Table 1 <br> Post-Secondary Education Enrolments 1976/77 to 1989/90

$\begin{array}{cc}=== & ========== \\ \text { Year } & === \\ \text { Enrolments }\end{array}$


| 1976 | 2684 |
| :--- | :--- |
| 1977 | 3599 |
| 1978 | 4148 |
| 1979 | 4502 |
| 1980 | 4999 |
| 1981 | 6156 |
| 1982 | 6810 |


Year Enrolments = = = = = = = = = = = = = = = = = = = =
$1983 \quad 8062$
$1984 \quad 8567$
$1985 \quad 12164$
$1986 \quad 14914$
$1987 \quad 15921$
$1988 \quad 15572$
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

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.

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 (eg. Alberta). Apparently, there is a problem of reconciliation between regional data and $H Q$ 's data. This problem is presently under study by the Education Program. Furthermore some regions are using a manual database which makes it more difficult to retrieve 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 analysfs 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, Docunent 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 caused 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 $\mathrm{c}-31$ and UCEP students are available from 1985.

The next graph presents the series of enrolments from which the c31 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 $\mathrm{C}-31$ 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 anged 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 mediun growth scenario of the Registered Indian Population projections. INAC, 1989.

The participation rates series is presented on the next graph.

## Post-secondary participation rates (total enrolments/pop 18-34)



The shape of the curve resembles a lot to the one observed earlier for the enrolment series. The 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 conpared.

Three unpublished sets of projections (A: low, B: medium and $\mathrm{c}:$ high) of Canadian enrolments by age and sex t.o 1998/90 were obtained from (STC). The last historica] year is 1988/89 and the first projected year is 1989/90. Data on population counts (historical and projections by dar and by sex) were also part of the package (for more detoils 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 objectiveb 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 Il 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 x data.

* Participation rate: $\frac{\text { totalenrolments }}{\text { population aged 18-34 }}$

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 tine enrolments are based on a national average of historical data (1985 to 1989). The average was computed taking into account that $95 \%$ of the CCEP 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 tern (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 historjcal 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 $\left(R^{2}\right)$ can only be used when a linear adjustment is 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. The interpretation of this statistic is the following : on average, the error made when estimating the true value is plus or minus the MAD value. It does not measure the percentage of 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 $\pm .0065$.

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 .

### 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 (redium 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.

## Long term forecasting, approach 2 Logistic curve



The logistic curve fits well the observed pattern of the participation rate series. Since the logistic curve is a linear regression performed on transformed data it is interesting to look at the coefficient of determination $R$ which gives an idea of the gqodness of the fit. Eor 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 value. The saturation level depends on how one plays 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, nedium and low. The rate of damping is progressively increased as one moves from the high to low scendrios. 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, anong 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.

## 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 determing 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.

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 S'IUDEN'SS.

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 açed 18 to 34. without any regards to the level of education, this mumer represents the pool of potential post-secondary students. However, if the level of education is taken into acculant, not all these persons will be qualified to attend postsecondary school.

Generally speaking, the students who attend grade 12 or grade 13, even if they do not graduate fron high school dre 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.

School data on Indiats living off-reserve are not available. In wivar 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 estinate of 26941 off-reserve students who will attend grade 12 or grade 13. The total for both on and off-reserve is equal to 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 persuns who have less then a grade 12 and pursue post-secondary studies.
3) On average (1984 to 1988), only $20 \%$ of the 18 yeart old on-reserve registered Indians graduatey from high school each year compare to $60 \%$ of the 18 yearsold Canadians It is expected that this ratio will inprove through the years and reach a level comparable to the Canadian students. The number of potential postsecondary students will increase accordingly.
4) Furthernore, it is believed that off-reserve students behave differently thon on-reserve students reydraing 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 fron 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 impach of these factors.

## 5. CRYSTALLIZATION STAGE, MODEI, II

The main purpose of the crystallization stage of model ll 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 earh regional office in order to obtain more detajled 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 $H \mathscr{L}$ 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 sumary of the results of the study. As mentioned earlier, (section 2.3.3) a problem of reconciliation between the $H Q$ 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 $H Q$ 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 munter of enrolnents by region and by approach.

A secondary goal of the Model II stage has been the derejoprent of other forecasting methods such as projections of enrolnents instead of participation rates and the study of the correlation between grades $G 12+G 13$ and post-secondary enrolments. The results of the studjes exploring these approdches 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 andyze earh situation separately, looking at all the factors that ray 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 logistio 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 errolment figures (historical) arm 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 userfriendly 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 systen has some knowledge of LOTUS 123 and is fully fanjliar wifh the methodology of the volume side of the PS-LTCY.

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## APPENDIX A

## LIST OF CONTACTS

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

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

PURPOSE: 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 postsecondary school.

ACTIONS: $\quad \begin{aligned} & \text { None. M. Clark is available for questions or other } \\ & \text { requests. }\end{aligned}$
2. ORGANIZATION: Employment and Immigration Canada (ElC)

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

PURPOSE: Obtain data or forecasting model for volune side (and cost)

ANSWER: Obtained documentation on COPS, Canadian occupational Projection System.

ACTIONS: None.
3. ORGANIZATION: Council Ministers of Education Canada (CMEC)
$\begin{array}{ll}\text { Date: } & \text { February } 1990 \\ \text { Contact name: Mme Nicole Davignon }\end{array}$
Phone number: (416) 964-2551

PURPOSE: 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 commanty Colleges (CACC)

Date: February 1990
Contact name: Mme Micheline Reid
phone number: (416) 489-5925
PURPOSE: Obtain data or forecasting model for volume side (and cost side).

ANSWER: Nothing on the volure side. Suggestion: provinces

Cost side contact Susanne Robinson.
ACTIONS: Enile is suppose to follow-ap 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
PURPOSE: 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 Eederation of Students

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

PURPOSE: Obtain data or forecasting model for volume side (and cost)

ANSWER: Nothing interesting
ACTIONS: None

## APPENDIX B

## DATA

This appendix contains the data used for Model I.

## Historical data

| Year | Populat aged 18 | Enrol. | Part. rat | $\begin{aligned} & \text { Full } \\ & \text { time } \end{aligned}$ | $\begin{aligned} & \text { Part } \\ & \text { tim } \end{aligned}$ | C-31 | UCEP |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 76 | 78514 | 2684 | 0.0342 | $\mathrm{n} / \mathrm{a}$ | $n / d$ | $\mathrm{n} / \mathrm{a}$ | $\mathrm{n} / \mathrm{a}$ |
| 77 | 82156 | 3599 | 0.0438 | $n / \mathrm{a}$ | $\mathrm{n} / \mathrm{a}$ | $\mathrm{n} / \mathrm{a}$ | $\mathrm{n} / \mathrm{d}$ |
| 78 | 86210 | 4148 | 0.0481 | $n / a$ | $\mathrm{r} / \mathrm{a}$ | $\mathrm{n} / \mathrm{a}$ | $\mathrm{n} / \mathrm{d}$ |
| 79 | 90462 | 4502 | 0.0498 | $\mathrm{n} / \mathrm{a}$ | $\mathrm{n} / \mathrm{a}$ | $\mathrm{n} / \mathrm{a}$ | $\mathrm{n} / \mathrm{a}$ |
| 80 | 94640 | 4999 | 0.0528 | $\mathrm{n} / \mathrm{a}$ | $\mathrm{r} / \mathrm{a}$ | $\mathrm{n} / \mathrm{a}$ | $n / a$ |
| 81 | 99100 | 6156 | 0.0621 | $\mathrm{n} / \mathrm{a}$ | n/a | $\mathrm{n} / \mathrm{a}$ | $\mathrm{n} / \mathrm{a}$ |
| 82 | 103424 | 6810 | 0.0658 | $\mathrm{n} / \mathrm{a}$ | $n / a$ | $\mathrm{n} / \mathrm{a}$ | $\mathrm{n} / \mathrm{a}$ |
| 83 | 108180 | 8062 | 0.0745 | $n / \mathrm{a}$ | $n / a$ | $\mathrm{n} / \mathrm{a}$ | $n / a$ |
| 84 | 113096 | 8567 | 0.0757 | n/a | $\mathrm{n} / \mathrm{a}$ | n/a | $\mathrm{n} / \mathrm{a}$ |
| 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
93 169463
94 170212
95 170534
96 170602
97 170610
98 170487
99 170438
100 170393
```

NOTE: Enrolment and population data exclude the NWT region.

## 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, elr
Progran: Type of program (math, biology et.c.)
Address: Temporary (while at school)
Address: Permanent
Birth date (age)
Allowance category: single living at home with mrent 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 af 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 coning "fresh" from high school or from UCEP program fromall the others. It may also become important to identify the students who are going back to school after a certain period of tirne (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 insteak of characters. Use of uniform coding and definition should be pronoted acruss 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 prograra 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 reguired for enrolment projections may also change. Furthermore, Eduration Branch certainly has additional needs regarding post-secondary data.

## APPENDIX D

## 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. $\mathrm{C}-31$

The following table contains data on $\mathrm{C}-31^{\prime} \mathrm{s}$. As observed, the number of $\mathrm{C}-31$ 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 al] the years.

## C-31 data


Year Enrolment $\quad \mathrm{C}$-31 pop C -31 Non $\mathrm{C}-31$
(C-31) age 18-34 part. rate part. rate


| 85 | 446 | 546 | $(1)$ | 0.8173 |
| ---: | ---: | ---: | ---: | ---: |
| 86 | 1284 | 6158 | 0.2085 | 0.0996 |
| 87 | 2188 | 13329 | 0.1642 | 0.1114 |
| 88 | 2907 | 19824 | 0.1466 | 0.0968 |
| 89 | 3818 | 25679 | 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 $\mathrm{C}-31$ aged 18-34.

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

| Year | Number of UCEP | Total enrolment | \% |
| :---: | :---: | :---: | :---: |
| 85 | 994 | 12164 | . 08 |
| 86 | 1718 | 14914 | . 12 |
| 87 | 1679 | 15921 | . 11 |
| 88 | 1613 | 15572 | . 10 |

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 enrolnents 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


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.

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. Ithas 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.


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

## APPENDIX E

## STATISTICS CANADA PROJECTIONS

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

Three unpublished projections ( $A B C$ ) 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 $S T C$ 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 enrolnent 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.

Post-secondary education
Canadian participation rates


## APPENDIX F

## RESULTS: SHORT TERM APPROACH: Linear regression.

Response variable: Participation rate ==> $P$
Predictor variable: Year ==> Y

The adjusted model:

$$
\begin{aligned}
\mathrm{P}= & -.4835+.0068 \mathrm{Y}+\mathrm{e} \\
& \text { where e is the error term. } \\
R^{2}= & .9283
\end{aligned}
$$

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 regressjon

REGRESSION (short term forecasting)

## Lower 95 \% confidence interval

| Year | $\begin{aligned} & \text { Participation } \\ & \text { rate } \end{aligned}$ | Enrolment | $\begin{aligned} & \text { Full-time } \\ & (0.8761) \end{aligned}$ | $\begin{aligned} & \text { Part-time } \\ & (0.1239) \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: |
| 90 | 0.1165 | 19281 | 16892 | 2389 |
| 91 | 0.1222 | 20440 | 17907 | 2533 |
| 92 | 0.1279 | 21550 | 18880 | 2670 |

## Regression

 Year Participation Enrolment Full-time Part-time rate
(0.8761) (0.1239)


| 90 | 0.1265 | 20952 | 18356 | 2596 |
| :--- | :--- | :--- | :--- | :--- |
| 91 | 0.1333 | 22305 | 19541 | 2764 |
| 92 | 0.1401 | 23611 | 20685 | 2926 |

Upper $95 \%$ confidence interval
 Year Participation Enrolment Full-time Part-time
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



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

## APPENDIX G

## 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 $\mathrm{C}-31$ 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



| 76 | 78514 | 2684 | 0.0342 |
| :--- | ---: | ---: | ---: |
| 77 | 82156 | 3599 | 0.0438 |
| 78 | 86210 | 4148 | 0.0481 |
| 79 | 90462 | 4502 | 0.0498 |
| 80 | 94640 | 4999 | 0.0528 |
| 81 | 99100 | 6156 | 0.0621 |
| 82 | 103424 | 6810 | 0.0658 |
| 83 | 108180 | 8062 | 0.0745 |
| 84 | 113096 | 8567 | 0.0757 |
| 85 | 117691 | 11718 | 0.0996 |
| 86 | 122342 | 13630 | 0.1114 |
| 87 | 126211 | 13733 | 0.1088 |
| 88 | 130854 | 12665 | 0.0968 |
| 89 | 133291 | 14717 | 0.1104 |
| 90 | 134296 |  |  |
| 91 | 136124 |  |  |
| 92 | 137525 |  |  |

The model :
Response variable : participation rate without $C-31==$ PhC-31 Predictor variable : Year ==3 Y

The adjusted model :

$$
\begin{aligned}
\text { PWC }-31= & -.4401+.0062 \mathrm{Y}+\mathrm{e} \\
& \text { Where e is the error term } \\
\mathrm{R}^{2}= & .9273
\end{aligned}
$$

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 $1989=.1166$ |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |
| Year | Participation rate | Enrolment | $\begin{gathered} \text { Full-time } \\ (0.8761) \end{gathered}$ | $\begin{aligned} & \text { Part-time } \\ & (0.1239) \end{aligned}$ |
| 90 | 0.1166 | 19305 | 16913 | 2392 |
| 91 | 0.1166 | 19507 | 17090 | 2417 |
| 92 | 0.1166 | 19650 | 17215 | 2435 |
| 93 | 0.1166 | 19758 | 17310 | 2448 |
| 94 | 0.1166 | 19846 | 17387 | 2459 |
| 95 | 0.1166 | 19883 | 17419 | 2464 |
| 96 | 0.1166 | 19891 | 17426 | 2465 |
| 97 | 0.1166 | 19892 | 17427 | 2465 |
| 98 | 0.1166 | 19878 | 17415 | 2463 |
| 99 | 0.1166 | 19872 | 17410 | 2462 |
| 100 | 0.1166 | 19867 | 17405 | 2462 |

## 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, \(i=1976, \ldots, 1989\)
                            \(p_{i}\) : participation rate, \(i=1976, \ldots, 1989\)
                (total enrolment \(\div\) population 18-34)
                            \(t_{i}\) : \(\operatorname{transformed~data}=\ln \left(\left(k / F_{i}\right)-1\right)\)
                            k : saturation level
1.1 Linear regression:
    \(T\) : response variable
    Y: predictor variable
    Model
    \(T=\alpha+\beta Y+\epsilon\)
        where \(\alpha\) : constant
            B: slope
            e: error term
    1.2 Projections: year 1990,..., 2000:
        \(t_{i}=\alpha+\beta y_{i}\)
            where \(\mathrm{i}=1990, \ldots, 2000\)
1.3 Transformation of \(t_{i}\) into \(p_{2}\) (estimated participation rate)
    \(p_{i}=k /\left(\exp \left(t_{2}\right)+1\right)\)
        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 | $\begin{aligned} & \text { Full-time } \\ & (0.8761) \end{aligned}$ | $\begin{gathered} \text { Part-time } \\ (0.1239 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: |
| 90 | 0.1289 | 21336 | 18692 | 2644 |
| 91 | 0.1356 | 22690 | 19878 | 2812 |
| 92 | 0.1420 | 23934 | 20968 | 2966 |
| 93 | 0.1480 | 25082 | 21974 | 3108 |
| 94 | 0.1536 | 26141 | 22902 | 3239 |
| 95 | 0.1587 | 27065 | 23711 | 3354 |
| 96 | 0.1634 | 27875 | 24421 | 3454 |
| 97 | 0.1676 | 28602 | 25058 | 3544 |
| 98 | 0.1715 | 29234 | 25611 | 3623 |
| 99 | 0.1749 | 29811 | 26117 | 3694 |
| 100 | 0.1780 | 30325 | 26567 | 3758 |

High scenario : saturation level $=.2186$

Year Participation Enrolment Full-time Part-time rate (0.8761)(0.1239)


| 90 | 0.1304 | 21583 | 18908 | 2675 |
| ---: | ---: | ---: | ---: | ---: |
| 91 | 0.1378 | 23057 | 20200 | 2857 |
| 92 | 0.1450 | 24435 | 21407 | 3028 |
| 93 | 0.1518 | 25731 | 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 | 27534 | 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 tö 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


Year $80=$ weighted average of Year 76 to Year 79
.. Step 2

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 $\alpha$, the weight factor.

The value of the weight factor ( $\alpha$ ) can vary from 0 to 1 . A Large value of $\alpha$ will give relatively more important weights to recent data then a small value of $\alpha$. In order to visualize this concept the next graph presents two examples of weights obtained using different values of $\alpha$. 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 $\alpha$ is used, the resulting exponential curve is more damped then when a large $\alpha$ 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 Enrolment Eull time Part time rate (0.8761) (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 | 2892 |
| 97 | 0.1368 | 23341 | 20449 | 2908 |
| 98 | 0.1377 | 23468 | 20560 | 2922 |
| 99 | 0.1383 | 23577 | 20655 | 2932 |

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

Year Participation Enrolment Full time Part time
rate (0.8761) (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 | 25879 | 22030 | 3116 |
| 97 | 0.1474 | 25341 | 22201 | 3140 |
| 98 | 0.1486 | 25504 | 22344 | 3160 |
| 99 | 0.1496 | 25634 | 22458 | 3176 |



## APPENDIX K

## PERCENTAGE OF ENROLMENTS BY REGION

Average of 1985-1989 (Data from Headquarters)

## Region

| Attlantic | $4.84 \%$ |
| :--- | ---: |
| 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 projer tions to obtain crude estimates of enrolments by region.

## APPENDIX L

## NUMBER OF ENROLMENTS BY REGION, BY APPROACH

## REGRESSION

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YしKON |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 0.0484 | 0.1098 | 0.3417 | 0.1074 | 0.1152 | 0.1263 | 0.1455 | 0.0057 |
| 90 | 20952 | 1015 | 2300 | 7160 | 2250 | 2413 | 2647 | 3049 | 119 |
| 91 | 22305 | 1080 | 2448 | 7622 | 2395 | 2569 | 2818 | 3246 | 127 |
| 92 | 23611 | 1144 | 2591 | 8069 | 2535 | 2719 | 2983 | 3436 | 134 |

Full time enrolments (.8761)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YUKON |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 90 | 18356 | 889 | 2015 | 6273 | 1971 | 2114 | 2319 | 2671 | 104 |
| 91 | 19541 | 947 | 2145 | 6678 | 2098 | 2250 | 2469 | 2844 | 111 |
| 92 | 20685 | 1002 | 2270 | 7069 | 2221 | 2382 | 2613 | 3010 | 117 |

Part time enrolments (.1239)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YLKON |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 90 | 2596 | 126 | 285 | 887 | 279 | 299 | 328 | 378 | 15 |
| 91 | 2764 | 134 | 303 | 945 | 297 | 318 | 349 | 402 | 16 |
| 92 | 2926 | 142 | 321 | 1000 | 314 | 337 | 370 | 426 | 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 dverage was computed taking into account that $95 \%$ of the UCEF students are enroled in full time study.

## REGRESSION

Lower 95\% confidence interval

Total enrolments (lower 95\% C.I.)

| 90 | 19281 | 934 | 2116 | 6589 | 2070 | 2221 | 2436 | 2806 | 109 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 91 | 20440 | 990 | 2243 | 6985 | 2195 | 2354 | 2582 | 2974 | 116 |
| 92 | 21550 | 1044 | 2365 | 7364 | 2314 | 2482 | 2722 | 3136 | 122 |

Full time enrolments (lower 95\% C.I.) (.8761)

| 90 | 16892 | 818 | 1854 | 5773 | 1814 | 1945 | 2134 | 2458 | 96 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 91 | 17907 | 867 | 1965 | 6119 | 1923 | 2062 | 2262 | 2606 | 102 |
| 92 | 18880 | 915 | 2072 | 6452 | 2027 | 2174 | 2385 | 2747 | 107 |

Part time enrolments (lower 95\% C.I.) (.1239)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YUKON |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 90 | 2389 | 116 | 262 | 816 | 257 | 275 | 302 | 348 | 14 |
| 91 | 2533 | 123 | 278 | 866 | 272 | 292 | 320 | 369 | 14 |
| 92 | 2670 | 129 | 293 | 912 | 287 | 307 | 337 | 389 | 15 |

## REGRESSION

Upper 95\% confidence interval

|  | National | AtL | Qc | ONT | MAN | SASK | ALB | C.B. | YUKON |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 0.0484 | 0.1098 | 0.3417 | 0.1074 | 0.1152 | 0.1263 | 0.1455 | 0.0057 |
| 90 | 22622 | 1096 | 2483 | 7731 | 2429 | 2605 | 2858 | 3292 | 128 |
| 91 | 24171 | 1171 | 2653 | 8260 | 2596 | 2784 | 3054 | 3517 | 137 |
| 92 | 25672 | 1244 | 2818 | 8773 | 2757 | 2957 | 3243 | 3736 | 146 |

Full time enrolments (upper 95\% C.1.) (.8761)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YLKON |
| ---: | :---: | ---: | :---: | :--- | :--- | :--- | :--- | :--- | ---: |
| 90 | 19819 | 960 | 2175 | 6773 | 2128 | 2282 | 2504 | 2884 | 112 |
| 91 | 21176 | 1026 | 2324 | 7236 | 2274 | 2439 | 2675 | 3082 | 120 |
| 92 | 22491 | 1089 | 2469 | 7686 | 2415 | 2590 | 2841 | 3273 | 128 |

Part time enrolments (upper 95\% C.I.) (.1239)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YLKON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | ---: | ---: |
| 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

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YOKON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 0.0484 | 0.1098 | 0.3417 | 0.1074 | 0.1152 | 0.1263 | 0.1455 | 0.0057 |
|  |  |  |  |  |  |  |  |  |  |
| 90 | 19305 | 935 | 2119 | 6597 | 2073 | 2223 | 2439 | 2809 | 110 |
| 91 | 19507 | 945 | 2141 | 6666 | 2095 | 2247 | 2464 | 2839 | 111 |
| 92 | 19650 | 952 | 2157 | 6715 | 2110 | 2263 | 2482 | 2859 | 112 |
| 93 | 19758 | 957 | 2169 | 6752 | 2122 | 2275 | 2496 | 2875 | 112 |
| 94 | 19846 | 961 | 2178 | 6782 | 2131 | 2286 | 2507 | 2888 | 113 |
| 95 | 19883 | 963 | 2182 | 6795 | 2135 | 2290 | 2512 | 2893 | 113 |
| 96 | 19891 | 964 | 2183 | 6797 | 2136 | 2291 | 2513 | 2895 | 113 |
| 97 | 19892 | 964 | 2183 | 6798 | 2136 | 2291 | 2513 | 2895 | 113 |
| 98 | 19878 | 963 | 2182 | 6793 | 2135 | 2289 | 2511 | 2893 | 113 |
| 99 | 19872 | 963 | 2181 | 6791 | 2134 | 2289 | 2510 | 2892 | 113 |
| 100 | 19867 | 962 | 2181 | 6789 | 2133 | 2288 | 2510 | 2891 | 113 |

Full time enrolments (.8761)
National ATL QC ONT MAN SASK ALB C.B. YUKON

| 90 | 16913 | 819 | 1856 | 5780 | 1816 | 1948 | 2137 | 2461 | 96 |
| ---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 91 | 17090 | 828 | 1876 | 5840 | 1835 | 1968 | 2159 | 2487 | 97 |
| 92 | 17215 | 834 | 1889 | 5883 | 1849 | 1983 | 2175 | 2505 | 98 |
| 93 | 17310 | 838 | 1900 | 5915 | 1859 | 1994 | 2187 | 2519 | 98 |
| 94 | 17387 | 842 | 1908 | 5942 | 1867 | 2002 | 2197 | 2530 | 99 |
| 95 | 17419 | 844 | 1912 | 5953 | 1870 | 2006 | 2201 | 2535 | 99 |
| 96 | 17426 | 844 | 1913 | 5955 | 1871 | 2007 | 2201 | 2536 | 99 |
| 97 | 17427 | 844 | 1913 | 5955 | 1871 | 2007 | 2202 | 2536 | 99 |
| 98 | 17415 | 844 | 1911 | 5951 | 1870 | 2006 | 2200 | 2534 | 99 |
| 99 | 17410 | 843 | 1911 | 5950 | 1869 | 2005 | 2199 | 2534 | 99 |
| 100 | 17405 | 843 | 1910 | 5948 | 1869 | 2004 | 2199 | 2533 | 99 |

part time enrolments (.1239)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YLKON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 90 | 2392 | 116 | 263 | 817 | 257 | 275 | 302 | 348 | 14 |
| 91 | 2417 | 117 | 265 | 826 | 260 | 278 | 305 | 352 | 14 |
| 92 | 2435 | 118 | 267 | 832 | 261 | 280 | 308 | 354 | 14 |
| 93 | 2448 | 119 | 269 | 837 | 263 | 282 | 309 | 356 | 14 |
| 94 | 2459 | 119 | 270 | 840 | 264 | 283 | 311 | 358 | 14 |
| 95 | 2464 | 119 | 270 | 842 | 265 | 284 | 311 | 359 | 14 |
| 96 | 2465 | 119 | 271 | 842 | 265 | 284 | 311 | 359 | 14 |
| 97 | 2465 | 119 | 271 | 842 | 265 | 284 | 311 | 359 | 14 |
| 98 | 2463 | 119 | 270 | 842 | 264 | 284 | 311 | 358 | 14 |
| 99 | 2462 | 119 | 270 | 841 | 264 | 284 | 311 | 358 | 14 |
| 100 | 2462 | 119 | 270 | 841 | 264 | 284 | 311 | 358 | 14 |

## LOGISTIC CURVE High scenario

Total enrolments

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YUKON |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
|  |  | 0.0484 | 0.1098 | 0.3417 | 0.1074 | 0.1152 | 0.1263 | 0.1455 | 0.0057 |
| 90 | 21583 | 1045 | 2369 | 7376 | 2318 | 2486 | 2727 | 3141 | 122 |
| 91 | 23057 | 1117 | 2531 | 7879 | 2476 | 2655 | 2913 | 3355 | 131 |
| 92 | 24435 | 1184 | 2682 | 8350 | 2624 | 2814 | 3087 | 3556 | 139 |
| 93 | 25731 | 1246 | 2824 | 8793 | 2763 | 2963 | 3251 | 3744 | 146 |
| 94 | 26948 | 1305 | 2958 | 9209 | 2894 | 3103 | 3404 | 3921 | 153 |
| 95 | 28034 | 1358 | 3077 | 9580 | 3010 | 3229 | 3542 | 4080 | 159 |
| 96 | 29009 | 1405 | 3184 | 9913 | 3115 | 3341 | 3665 | 4221 | 165 |
| 97 | 29900 | 1448 | 3282 | 10218 | 3211 | 3443 | 3777 | 4351 | 170 |
| 98 | 30694 | 1487 | 3369 | 10489 | 3296 | 3535 | 3878 | 4467 | 174 |
| 99 | 31428 | 1522 | 3449 | 10740 | 3375 | 3619 | 3970 | 4573 | 178 |
| 100 | 32093 | 1555 | 3522 | 10967 | 3446 | 3696 | 4054 | 4670 | 182 |

Full time enrolments (.8761)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YCKON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | ---: |
| 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 | 2637 | 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)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YLKON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | ---: | ---: |
| 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 | 1187 | 373 | 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

Total enrolments

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YLKON |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
|  |  | 0.0484 | 0.1098 | 0.3417 | 0.1074 | 0.1152 | 0.1263 | 0.1455 | 0.0057 |
| 90 | 21336 | 1033 | 2342 | 7291 | 2291 | 2457 | 2695 | 3105 | 121 |
| 91 | 22690 | 1099 | 2490 | 7754 | 2436 | 2613 | 2866 | 3302 | 129 |
| 92 | 23934 | 1159 | 2627 | 8179 | 2570 | 2756 | 3024 | 3483 | 136 |
| 93 | 25082 | 1215 | 2753 | 8571 | 2693 | 2889 | 3169 | 3650 | 142 |
| 94 | 26141 | 1266 | 2869 | 8933 | 2807 | 3011 | 3302 | 3804 | 148 |
| 95 | 27065 | 1311 | 2971 | 9249 | 2906 | 3117 | 3419 | 3939 | 154 |
| 96 | 27875 | 1350 | 3059 | 9526 | 2993 | 3210 | 3521 | 4056 | 158 |
| 97 | 28602 | 1385 | 3139 | 9774 | 3071 | 3294 | 3613 | 4162 | 162 |
| 98 | 29234 | 1416 | 3209 | 9990 | 3139 | 3367 | 3693 | 4254 | 166 |
| 99 | 29811 | 1444 | 3272 | 10187 | 3201 | 3433 | 3766 | 4338 | 169 |
| 100 | 30325 | 1469 | 3328 | 10363 | 3256 | 3492 | 3831 | 4413 | 172 |

Full time enrolments (.8761)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YLKON |
| ---: | :---: | ---: | :---: | :---: | :---: | :---: | :---: | :---: | ---: |
| 90 | 18692 | 905 | 2052 | 6388 | 2007 | 2153 | 2361 | 2720 | 106 |
| 91 | 19878 | 963 | 2182 | 6793 | 2135 | 2289 | 2511 | 2893 | 113 |
| 92 | 20968 | 1016 | 2301 | 7165 | 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 | C.B. | YCKON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | 373 | 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 | 527 | 21 |
| 99 | 3694 | 179 | 405 | 1262 | 397 | 425 | 467 | 538 | 21, |
| 100 | 3758 | 182 | 412 | 1284 | 404 | 433 | 475 | 547 | 21. |

## DAMPED EXPONENTIAL High scenario

Total enrolments

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YLKON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | ---: | ---: | ---: |
|  |  | 0.0484 | 0.1098 | 0.3417 | 0.1074 | 0.1152 | 0.1263 | 0.1455 | 0.0057 |
| 90 | 21059 | 1020 | 2311 | 7196 | 2261 | 2425 | 2660 | 3065 | 120 |
| 91 | 22699 | 1100 | 2491 | 7757 | 2437 | 2614 | 2868 | 3303 | 129 |
| 92 | 24008 | 1163 | 2635 | 8204 | 2578 | 2765 | 3033 | 3494 | 136 |
| 93 | 25060 | 1214 | 2751 | 8564 | 2691 | 2886 | 3166 | 3647 | 142 |
| 94 | 25910 | 1255 | 2844 | 8854 | 2782 | 2984 | 3273 | 3770 | 147 |
| 95 | 26551 | 1286 | 2914 | 9073 | 2851 | 3058 | 3354 | 3864 | 151 |
| 96 | 27036 | 1310 | 2967 | 9239 | 2903 | 3114 | 3415 | 3934 | 153 |
| 97 | 27416 | 1328 | 3009 | 9369 | 2944 | 3157 | 3463 | 3990 | 156 |
| 98 | 27700 | 1342 | 3040 | 9466 | 2974 | 3190 | 3499 | 4031 | 157 |
| 99 | 27934 | 1353 | 3066 | 9546 | 3000 | 3217 | 3529 | 4065 | 159 |
| 100 | 28121 | 1362 | 3086 | 9610 | 3020 | 3239 | 3553 | 4092 | 160 |

Full time enrolments (.8761)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YCKON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | ---: |
| 90 | 18449 | 894 | 2025 | 6305 | 1981 | 2125 | 2331 | 2685 | 105 |
| 91 | 19886 | 963 | 2183 | 6796 | 2135 | 2290 | 2512 | 2894 | 113 |
| 92 | 21033 | 1019 | 2309 | 7188 | 2259 | 2422 | 2657 | 3061 | 119 |
| 93 | 21955 | 1063 | 2410 | 7503 | 2358 | 2528 | 2774 | 3195 | 125 |
| 94 | 22699 | 1100 | 2491 | 7757 | 2437 | 2614 | 2868 | 3303 | 129 |
| 95 | 23261 | 1127 | 2553 | 7949 | 2498 | 2679 | 2939 | 3385 | 132 |
| 96 | 23686 | 1147 | 2600 | 8094 | 2543 | 2728 | 2992 | 3447 | 134 |
| 97 | 24019 | 1163 | 2636 | 8208 | 2579 | 2766 | 3034 | 3495 | 136 |
| 98 | 24267 | 1175 | 2663 | 8293 | 2606 | 2795 | 3066 | 3531 | 138 |
| 99 | 24473 | 1185 | 2686 | 8363 | 2628 | 2818 | 3092 | 3561 | 139 |
| 100 | 24636 | 1193 | 2704 | 8419 | 2645 | 2837 | 3112 | 3585 | 140 |

Part time enrolments (.1239)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YChON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | ---: | ---: |
| 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 | 18 |
| 95 | 3290 | 159 | 361 | 1124 | 353 | 379 | 416 | 479 | 19 |
| 96 | 3350 | 162 | 368 | 1145 | 360 | 386 | 423 | 487 | 19 |
| 97 | 3397 | 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

|  | National | ATL | Qc | ONT | MAN | SASK | ALB | C.B. | YLKON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | ---: |
|  |  | 0.0484 | 0.1098 | 0.3417 | 0.1074 | 0.1152 | 0.1263 | 0.1455 | 0.0057 |
| 90 | 20505 | 993 | 2251 | 7007 | 2202 | 2361 | 2590 | 2984 | 116 |
| 91 | 21717 | 1052 | 2384 | 7421 | 2332 | 2501 | 2744 | 3160 | 123 |
| 92 | 22679 | 1099 | 2489 | 7750 | 2435 | 2612 | 2865 | 3300 | 129 |
| 93 | 23451 | 1136 | 2574 | 8014 | 2518 | 2701 | 2963 | 3413 | 133 |
| 94 | 24074 | 1166 | 2642 | 8227 | 2585 | 2773 | 3041 | 3503 | 137 |
| 95 | 24536 | 1189 | 2693 | 8385 | 2635 | 2826 | 3100 | 3570 | 139 |
| 96 | 24879 | 1205 | 2731 | 8502 | 2672 | 2865 | 3143 | 3620 | 141 |
| 97 | 25146 | 1218 | 2760 | 8593 | 2700 | 2896 | 3177 | 3659 | 144 |
| 98 | 25341 | 1227 | 2781 | 8660 | 2721 | 2918 | 3201 | 3688 | 144 |
| 99 | 25504 | 1235 | 2799 | 8715 | 2739 | 2937 | 3222 | 3711 | 145 |
| 100 | 25634 | 1242 | 2814 | 8760 | 2753 | 2952 | 3238 | 3730 | 145 |

Full time enrolments (.8761)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YLKON |
| ---: | ---: | ---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 90 | 17964 | 870 | 1972 | 6139 | 1929 | 2069 | 2269 | 2614 | 102 |
| 91 | 19026 | 922 | 2088 | 6502 | 2043 | 2191 | 2404 | 2769 | 108 |
| 92 | 19869 | 962 | 2181 | 6790 | 2134 | 2288 | 2510 | 2891 | 113 |
| 93 | 20545 | 995 | 2255 | 7021 | 2206 | 2366 | 2595 | 2990 | 117 |
| 94 | 21091 | 1022 | 2315 | 7207 | 2265 | 2429 | 2664 | 3069 | 120 |
| 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)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YUKON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | ---: |
| 90 | 2541 | 123 | 279 | 868 | 273 |  | 293 | 321 | 370 |
| 91 | 2691 | 130 | 295 | 920 | 289 | 310 | 340 | 392 | 14 |
| 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 scenarioTotal enrolments

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | YLKON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | ---: |
|  |  | 0.0484 | 0.1098 | 0.3417 | 0.1074 | 0.1152 | 0.1263 | 0.1455 | 0.0057 |
|  |  |  |  |  |  |  |  |  |  |
| 90 | 20019 | 970 | 2197 | 6841 | 2150 | 2306 | 2529 | 2913 | 114 |
| 91 | 20902 | 1012 | 2294 | 7143 | 2244 | 2407 | 2641 | 3042 | 119 |
| 92 | 21598 | 1046 | 2371 | 7381 | 2319 | 2487 | 2728 | 3143 | 123 |
| 93 | 22154 | 1073 | 2432 | 7571 | 2379 | 2551 | 2799 | 3224 | 126 |
| 94 | 22602 | 1095 | 2481 | 7724 | 2427 | 2603 | 2855 | 3289 | 128 |
| 95 | 22926 | 1111 | 2516 | 7835 | 2462 | 2640 | 2896 | 3336 | 130 |
| 96 | 23160 | 1122 | 2542 | 7914 | 2487 | 2667 | 2926 | 3370 | 131 |
| 97 | 23341 | 1131 | 2562 | 7976 | 2506 | 2688 | 2949 | 3397 | 132 |
| 98 | 23468 | 1137 | 2576 | 8020 | 2520 | 2703 | 2965 | 3415 | 133 |
| 99 | 23577 | 1142 | 2588 | 8057 | 2532 | 2715 | 2979 | 3431 | 134 |
| 100 | 23663 | 1146 | 2597 | 8086 | 2541 | 2725 | 2989 | 3443 | 134 |

Full time enrolments (.8761)

|  | National | ATL | QC | ONT | MAN | SASK | ALB | C.B. | 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 | C.B. | YLKON |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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

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 errolments based on the enrolments series.

The regression based on enrolments qave 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 logistie: 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 tho populations (eg. Caradians 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. Onlv on-reserve data were available to perform this study. On-reserve grade 12 and grade 13 enrolments were compared to enrolments for dl] lndian Post-secondary over the years

Students enroled in high school in vear Y were consjdered 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 | 83 |
| 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 graphin should be considered.

Fost-secondary eroments anc number of grace í + grace:3


The graphice 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-secundary enrolments seems to grow faster then the number of grade 12 and grade 13 students. Furthermore, the "bump observed in thespostsecondary 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 onr it. However, it gives an idea on how the on-reserve grade 12 and grade 13 enrolments have evolved over the yearsy compared to pöst-secondary enrolments.

