Student success analysis and prediction using the US community college microsimulation model MicroCC[1]

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D R A F T

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Abstract

Demographic change in connection with the recent economic crisis has led to changing enrolment numbers and a changing composition of the student population by age, sex, ethnicity, and the rate of fulltime attendance. Based on 2000-2009 administrative data on the study progression of 200.000 community college students in Connecticut and Rhode Island, we have developed the MicroCC model. MicroCC simulates study progressions of new students of various programs up to 10 terms, in each term deciding on re-enrolment, fulltime attendance, the number of courses taken, and study success for each course. This framework allows decomposing the considerable ethnic and gender differences in success rates to a variety of factors. We found that around half of the ethnic differences in study success can be attributed to the different initial fulltime enrolment rates, while the contribution of other factors like differences in dropout rates, course repetition, and the number of courses taken is highly specific to ethnic groups. These findings have major policy relevance. Besides serving as an analytical tool, MicroCC allows projection of course enrolment and graduation numbers under various scenarios.

Keywords: Education, microsimulation, study success, community college

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1. Introduction

In the United States since 2009, there have been a number of national and regional initiatives to improve completion success rates of students attending 2-year colleges (called community colleges) which are closely aligned with filling labor force demands. Typically, 60% or more of the students do not complete a degree, a certificate or transfer into a 4-year program within five years of first enrollment. A variety of projects have emerged to improve success rates for enrollees in these 2-year colleges called “community colleges.” These projects include Achieving the Dream (ATD), Common Completion Metrics (National Governors Association), Voluntary Framework of Accountability (AAAC), Foundations of Excellence in the First College Year (Gardner Institute), Complete College America, Achieve, Inc. and several initiatives using the labels of Action Analytics and Learning Analytics and Knowledge. These projects emphasize evidence-based, data driven approaches and have triggered the provision of longitudinal data based on administrative student records as the basis for high-powered, quantitative analysis and modeling.

In this contribution, we present the MicroCC microsimulation model which was developed to respond to the demands for analytic research tools for an enhanced understanding of student success pathways. As part of this project, facilitated by the New England Board on Higher Education (NEBHE), we produced two customized student enrollment databases. One contains all of Rhode Island Community College’s students in five annual cohorts of about 2,500 students each, beginning with fall 2005 enrollees. The second database includes about 200,000 Connecticut students in 10 cohorts that began with the fall 2000 cohort up to the fall 2009 cohort. The larger sample size of the latter allows distinguishing two broad fields of studies, namely technical studies (ATE - Advanced Technological Education) and non-technical studies. All statistical models underlying MicroCC were estimated separately for Rhode Island Community Colleges, Connecticut ATE programs and Connecticut non-ATE programs.

At the current state of development, MicroCC is predominantly used as an explorative model for producing illustrative uses of microsimulation in order to demonstrate the potential strengths of microsimulation supporting a better understanding – and eventually increasing - students’ success in community colleges. We propose to apply MicroCC in other college contexts and develop additional MSM models as decision and planning aids for college administrators including executives as well as IR directors, evaluators and other researchers. In the long run, our microsimulation research initiative follows various aims:

- Microsimulation allows quantifying the effect of individual level differences revealed in statistical analysis on the total outcome and thus a better understanding of which and how individual level differences impact student success;
- It serves as a projection tool capable of accounting for compositional changes in study entry cohorts, e.g. changes of the age or race composition, or the availability of financial aid;
- It can serve as a tool for policy analysis by quantifying policy effects on study speed and success. Policies can be of various types, e.g. changing the percentage of students receiving financial aid, or policies improving the odds of success of specific groups;
- It can serve as a tool for momentum point analysis. As it simulates study progressions on the individual level, it allows implementing momentum points. Students possess memory, and past experience, including momentum point attainment, can influence study speed and success;
- It can serve for capacity planning;
- It can reveal data requirements for future research and model improvements.

This contribution mainly focuses on the first point of the above list, i.e. the decomposition of student's success across different ethnical groups, gender, and programs.

The modeling of education pathways is – to some degree – part of most large scale microsimulation models, usually embedded with models of labor markets, family, tax, pension, welfare and other aspects of societal systems. Some of these models, like the LifePaths model in Canada and SESIM in Sweden are large multi-purpose life-course models that include the ability to explore the effects of educational policies, such as student loans. While education attainment is an important variable in most large dynamic microsimulation models, to our knowledge so far no microsimulation models until now were designed to investigate student college completion trajectories based on detailed longitudinal enrolment databases.

2. Data and statistical models

Our analysis is based on three databases of individual student enrolment and success histories. We used Connecticut data on non-technical and technical (ATE) programs including the histories of 180,635 respectively 16,621 students of the 2000-9009 (first) enrolment cohorts. The analysis of Rhode Island students is based on the 2005 (first) enrolment cohort. All students are followed over 4.5 years (9 terms).

The databases contained the following characteristics:

- Background factors of gender, race, age at first enrolment, and whether the first term enrollment was full-time (versus part-time);
- Term by term intermediate student decisions and behaviors: (1) the decision to re-enroll (or not) for each term; (2) the choice to enroll full-time or part-time each term; (3) the decision, based upon that choice, of how many courses to take during that term; (4) and the behavior of actually passing rather than failing each course.

The background factors are time-invariant and define the universe of characteristics in the starting population which is created from a frequency table of the students' characteristics observed in the three data bases (see Appendix I). Thus, for each initial enrolment cohort, the distributions are parameterized by sex, initial fulltime/part-time enrolment, four racial groups (white, black, Asian, other) and two age groups (below or equal / above 22). The size of the simulated population can be set by the user. (A typical population size is 5 million students, which is large enough to virtually eliminate Monte Carlo variability).

The term to term decision data correspond with the main behavioural modules of MicroCC. At the beginning of each term, it is first decided if a student (re) enrols, if he or she studies full- or part-time and how many courses are taken. At the end of each term, the study success of each of the courses taken is determined on a pass/fail basis. For the MicroCC model, nearly 30 separate logistic regressions were run to estimate the effects of background factors on intermediate student behaviors (see Appendix I). Our analysis reveals significant differences in all four behaviors by ethnical group, gender, and study program. How each of these differences ultimately translates into differences in success rates is illustrated in section 4.

While many alternative success criteria were explored, the success criterion used in this contribution was completion of 12 credit-based courses within 9 terms or 4.5 years. This simple criterion allows studying students' success without distinguishing the alternative successful outcomes, namely completion of a two year program or transfer to a 4 year program, the latter not identifiable from our data source.

3. The MicroCC model implementation

The MicroCC model is implemented in Modgen, a generic microsimulation programming language developed and maintained at Statistics Canada and widely used in social science microsimulation. Like all Modgen applications, MicroCC has an attractive user interface and can be published on the web. Users thus can study the model, model scenarios, and model results of public runs over the internet; logged in users can also create and run their own scenarios. The current version is a standard Windows version. More information on Modgen including download information for Modgen and MicroCC is provided in the Annex 2.

4. Illustration of results

Once the validity of the baseline simulation was confirmed by performing retrospective projections, the MicroCC model was used as a scenario tool to ask "what-if questions." For example, we obtained answers to the scenario question, what if the male-female gap in average number of courses taken were closed, how would this affect the gender gap in success rates over time. More often, we asked, what if the gap in all four student decisions and intermediate behaviors were closed for any two background categories, how would this affect the overall success rates? If one of our four background factors had been participation in an intervention program, then we could have answered the question: "Suppose all of the students experienced the intervention program, how would that change the overall success rate of the students over time?"

Illustration 1: Differences between White, Latin and Black students in Rhode Island

To illustrate how microsimulation can be used to isolate the forces underlying some racial gaps in completion, the results are shown in Figure 1 for analysis of the 17% gap between (Non-Hispanic) White students and Hispanic students in the 2005 cohort of the Community College of Rhode Island. Hispanic or Latin students had lower success rates. Of this difference, about 50% of this gap in the success trajectories stems from a different composition of the students' population at first enrolment, mainly a higher rate of initial fulltime students in the group of Whites. The second half stems from different behaviors in the following study decisions and success probabilities. Interestingly, Latin students have higher success probabilities concerning individual courses; the main gap stems from the higher probability to stay or switch to part-time studies.

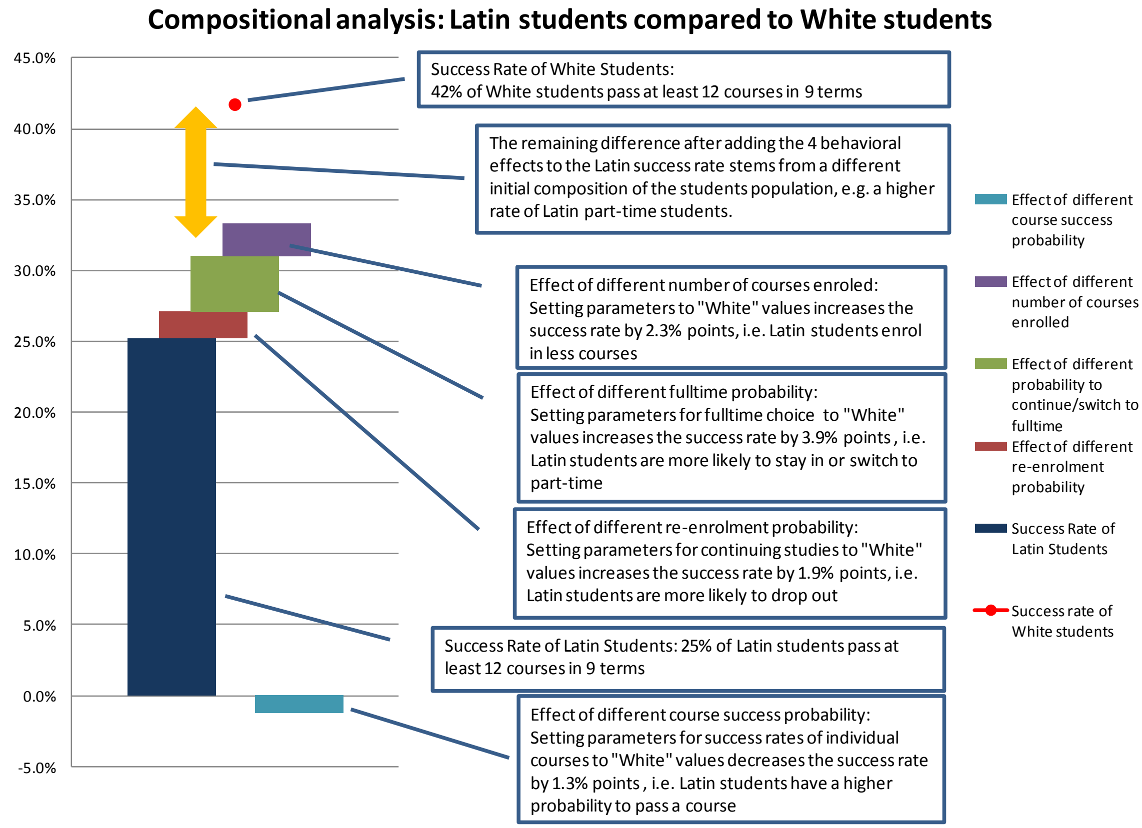


Figure 1: Compositional analysis of differences between two groups – Overview

Figure 2 gives a more detailed picture of the gaps in success rates. When controlling for the initial full-time/part-time status, the gap can be entirely attributed to the differences in the modeled decisions and course success rates. The gap in success rates is highest for female students, where part-time attendance and the probability to switch to part-time attendance are highest.

Figure 3 shows the equivalent illustration for the difference between Black and White students. Here the gender patterns are reversed in the sense, that the gap as is highest for male students, the main reason being smaller course success rates.

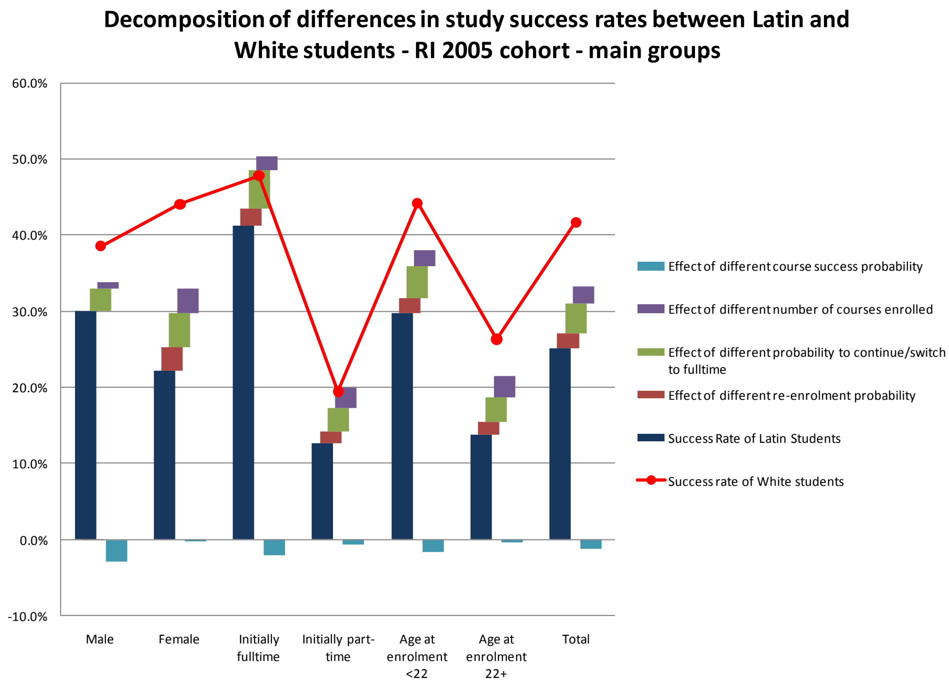


Figure 2: Compositional analysis of differences between Latin and White students - RI.

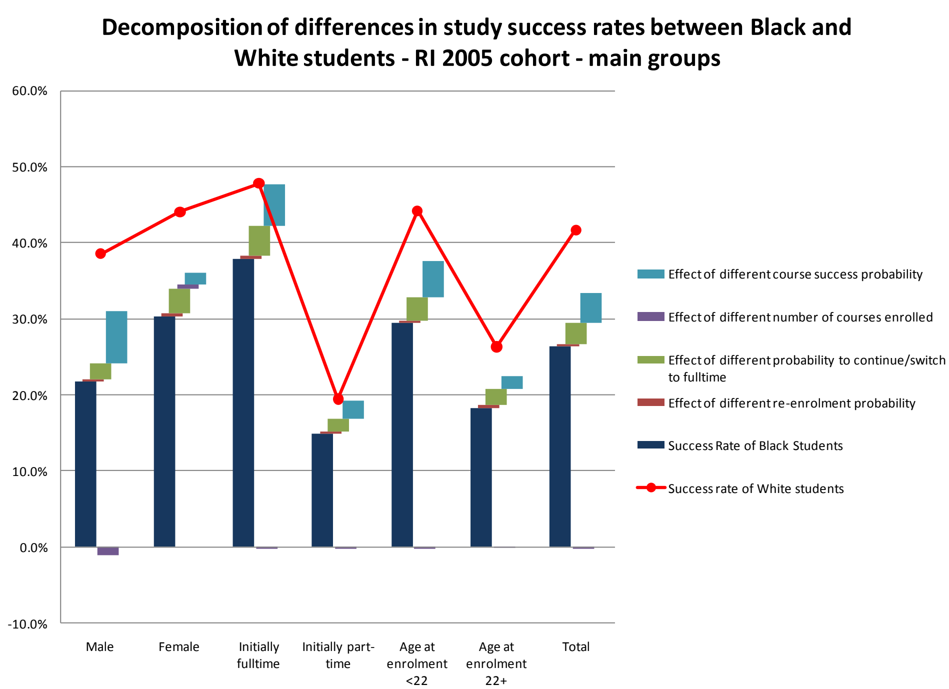


Figure 3: Compositional analysis of differences between White and Black students - RI

Illustration 2: Differences between Black and White students in Connecticut – ATE

Figure 4 depicts the differences in study success between Black and White technical (ATE) students in Connecticut. In contrast to Rhode Island, study success rates are generally higher and the racial gap far smaller, respectively completely absent in the case of initial part-time students.

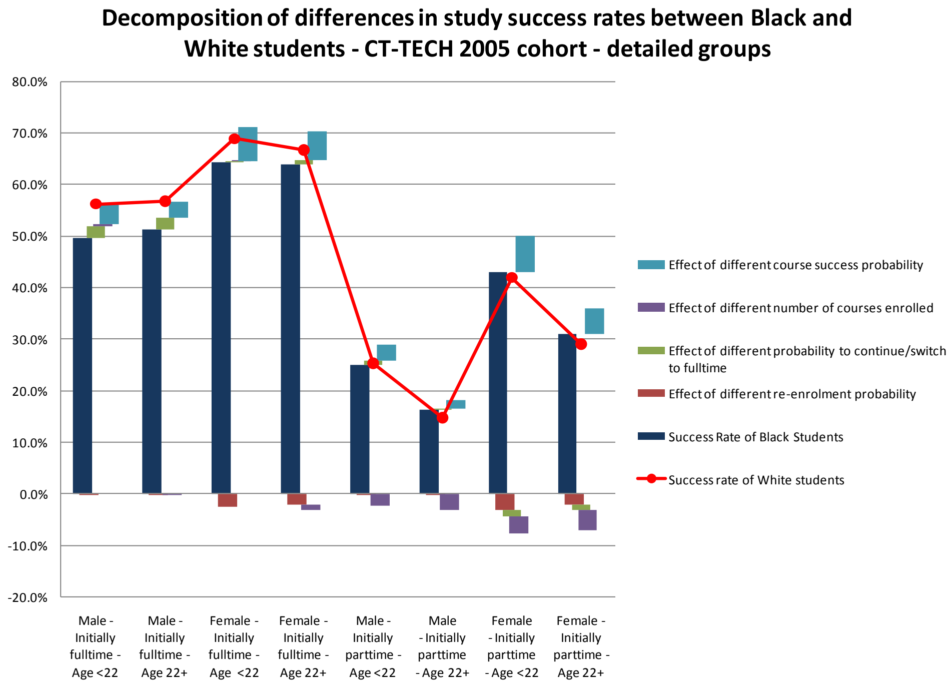


Figure 4: Differences between White and Black students – Connecticut ATE

Illustration 3: Differences between technical (ATE) and non-technical students in Connecticut

Figure 5 compares study success rates between technical (ATE) and non-technical students in Connecticut. While success rates are generally higher for technical students, the relative differences are highest for initial part-time students and for students of the older age cohort. In the latter two cases, success rates are twice as high in technical programs. When controlling for the initial full-time/part-time status, the difference can be almost entirely attributed to the different re-enrolment probabilities.

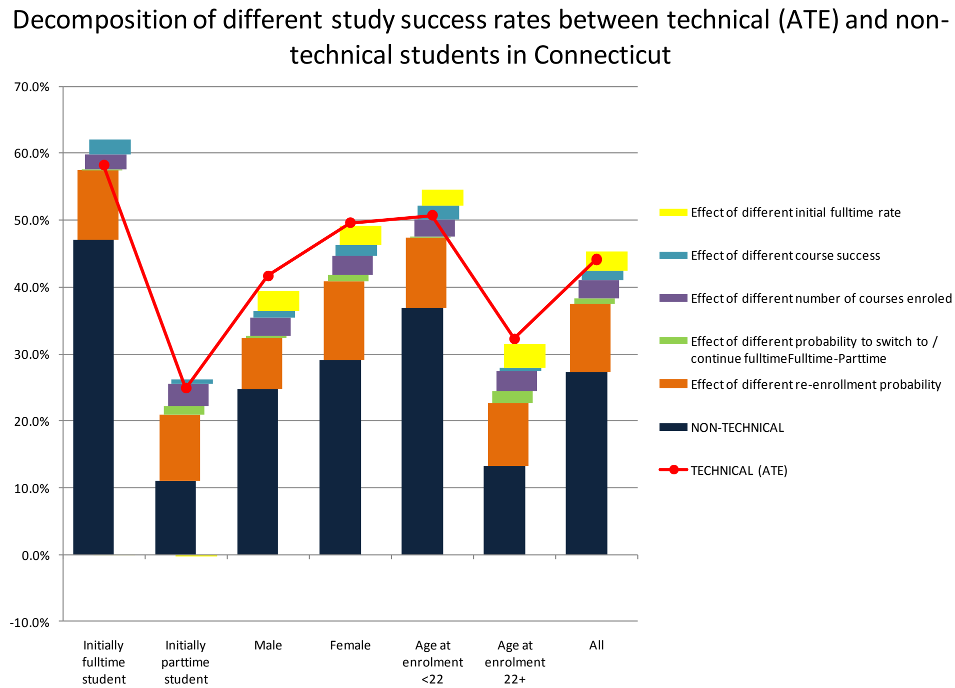


Figure 5: Differences between White and Black students – Connecticut ATE

Illustration 4: Overall trends in Connecticut success rates

Besides its use for decomposition analysis demonstrated above, MicroCC is a projection tool which can account for the changing composition of the students population over time. Connecticut student history data indicate increasing success rates for both the technical (ATE) and non-technical cohorts 2000-2004. Comparing these observed rates with MicroCC predictions (Figure 6) reveals, that this increase can entirely be attributed to the changing composition of students by sex, race, age and initial fulltime/part-time status, as the behavioral models – which do not include any time trends in behaviors – almost perfectly reproduce the observed rates. In absence of behavioral changes, the changing composition of students reflected in the enrolment data of entry cohorts after 2004 will lead to a continued upward trend in success rates. More in-depth analysis has shown that the increase in success rates can mainly be attributed to the increasing initial fulltime rates in the older age group of (especially white) students.

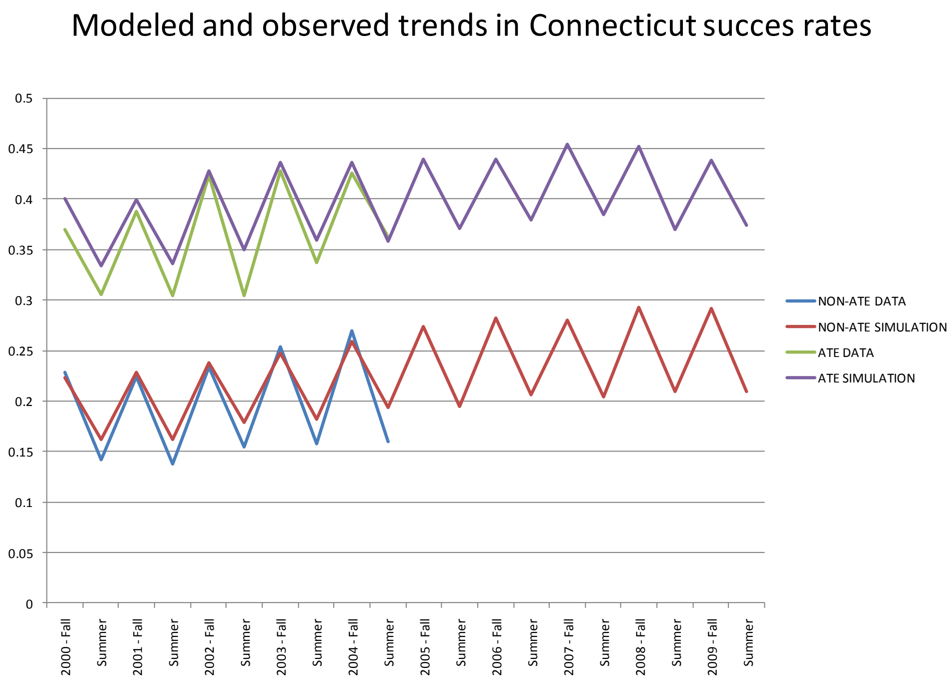


Figure 6: Observed and predicted success rates by enrolment cohort – Connecticut

6. Outlook

To date, MicroCC has mainly served as a proof of concept and demonstration of how the model can serve as an aid in planning and administrative decision-making in educational institutions. We believe that MicroCC can greatly enhance the growing number of strategies and tools for "students' success analytics. The microsimulation has utility not only for institutional administrators but program administrators and student counselors. For example, the earlier graphic illustrations provide compelling evidence for the detrimental effects of dropping enrollment for a term or even just dropping back from fulltime to part-time status.

To take advantage of the powerful microsimulation methodology described above, a selection or series of pilot projects are proposed for college institutions in New England. They will build upon the work already done in Rhode Island and Connecticut, expanding into new conceptual and technical territories. The New England Board of Higher Education (NEBHE) will serve as a coordinating center, managing the project and directing adequate technical assistance and training as needed to any individual project partner.

Presently, we are attempting to develop pilot projects and funding to implement the following applications of MicroCC:

- Job Market and Transfer Success. A college conducts an annual follow-up survey of graduates and transfer students. This data would be combined with the enrolment database already constructed for purposes of predicting student success rates in employment sectors or more advanced education. This study would produce evidence of the value added by the institution to the student's career trajectory after leaving. Demographic subpopulations could be tracked to examine if success gaps change significantly after leaving community college.
- Evaluation of a Campus-Wide Intervention. In another college, a pilot project would start with a baseline database construction and then as an intervention progresses, it would use MicroCC to tease out of the student progress data and any complex interactions among student attributes and exposure to different aspects of interventions. The fidelity of the evaluation will be enhanced by early planning for modeling of student success trajectories. The greatest potential of microsimulation can be achieved in education when what-if scenarios can be designed to include one or more interventions.
- Forecasting of Enrolments. Projections of student enrolments by background grouping could be done on a routine basis by adding together the results of cohort simulations. If the micro-data used by the model are current, enrolment and other student forecasting are considerably more accurate than macro-based projections because they use all the individual-level data. Requirements for future facilities and other resources can be more precisely estimated when the enrolment forecasting is more precise. The value of this type of information is most useful for state systems where decisions regarding opening or closing institutions need to be made and where the demand for trained technicians is heavily influenced by the frequent opening and closing of labor-intensive companies.

These and other such pilot projects will help to soften the resistance to innovative microsimulation tools within educational administration at various levels in educational systems. We have learned that "proof of concept" to the microsimulation expert is not necessarily proof of concept to the actual decision-makers, especially in education where the data and modeling requirements are relatively demanding.

Annex 1: Statistical models

a. Re-enrolment decision

	CT DATA				RI DATA	
	NON-TECHNICAL		TECHNICAL		ALL	
	Male	Female	Male	Female	Male	Female
Constant	0.3118 ***	0.5433 ***	0.9039 ***	1.3332 ***	1.2668 ***	1.5422 ***
Black	0.0202	0.0726 ***	0.0021	0.0662	-0.0145	-0.0170
Latin	0.1026 ***	0.0910 ***	-0.0025	-0.0033	0.0025	-0.1385 *
Other	0.0011	-0.0117	0.1286 **	-0.0280	-0.0745	-0.2771 ***
Age 22+	-0.1335 ***	-0.0335 ***	0.0530 *	0.0112	-0.3653 ***	-0.0326
Previouse term parttime	-0.6174 ***	-0.5593 ***	-0.4204 ***	-0.2993 ***	-0.3449 ***	-0.4967 ***
Previouse term inactive	-2.8860 ***	-3.0883 ***	-2.7846 ***	-2.8153 ***	-2.4334 ***	-2.5683 ***
Momentum	0.4787 ***	0.4331 ***	0.3106 ***	0.1679 ***	0.5012 ***	0.2334 ***
Study term 3	0.4560 ***	0.4363 ***	0.1015 **	0.0559	-0.6161 ***	-0.5541 ***
Study term 4	0.4833 ***	0.5211 ***	0.0340	0.0552	-0.1059	-0.1978 *
Study term 5	0.3360 ***	0.4380 ***	-0.0043	-0.1996 **	-0.8089 ***	-0.6912 ***
Study term 6	0.1615 ***	0.2649 ***	-0.2808 ***	-0.3441 ***	-0.7666 ***	-0.5449 ***
Study term 7	0.0037	0.1645 ***	-0.4209 ***	-0.3462 ***	-1.1788 ***	-0.7649 ***
Study term 8	-0.2128 ***	-0.0497 **	-0.6847 ***	-0.6721 ***	-1.2589 ***	-1.0084 ***
Study term 9	-0.3927 ***	-0.1071 ***	-0.7064 ***	-0.7326 ***	-1.6325 ***	-1.2032 ***

b. Decision to study full-time

Previouse term fulltime	CT DATA				RI DATA	
	NON-TECHNICAL		TECHNICAL		ALL	
	Male	Female	Male	Female	Male	Female
Constant	1.0973 ***	0.9526 ***	1.0676 ***	0.9162 ***	1.2430 ***	1.2994 ***
Black	-0.4686 ***	-0.2817 ***	-0.4350 ***	-0.2672 *	-0.3555	-0.7721 ***
Latin	-0.4765 ***	-0.4081 ***	-0.4440 ***	-0.4028 ***	-0.3522 *	-0.8819 ***
Other	-0.1134	-0.0645	-0.1483	0.1013	0.1856	-0.5350 ***
Age 22+	-0.5626 ***	-0.7163 ***	-0.5990 ***	-0.6093 ***	-0.6489 **	-1.3892 ***
Momentum	0.6837 ***	0.7562 ***	0.7888 ***	0.5820 ***	0.6362 ***	0.9631 ***

Previouse term part-time	CT DATA				RI DATA	
	NON-TECHNICAL		TECHNICAL		ALL	
	Male	Female	Male	Female	Male	Female
Constant	-1.1950 ***	-1.4195 ***	-1.1446 ***	-1.3784 ***	-0.7482 ***	-1.2750 ***
Black	0.0801	0.1723 ***	0.1178	0.0430	-0.0185	-0.0580
Latin	-0.1058 *	-0.1205 ***	-0.1686	0.2772 **	-0.3154	-0.2480
Other	0.1668 *	0.2944 ***	0.1854	0.5501 ***	-0.3051	0.3417
Age 22+	-1.4293 ***	-1.2848 ***	-1.2024 ***	-0.9733 ***	-1.6903 ***	-0.6056 ***
Momentum	0.9205 ***	0.9306 ***	0.7473 ***	0.9838 ***	0.4633 **	0.6810 ***

Previouse term not enrolled	CT DATA				RI DATA	
	NON-TECHNICAL		TECHNICAL		ALL	
	Male	Female	Male	Female	Male	Female
Constant	-0.6743 ***	-0.9452 ***	-0.5294 ***	-0.9521 ***	-0.2856 *	-0.7477 ***
Black	-0.1414 *	0.1339 **	-0.1216	0.6125 ***	-0.7920 **	0.2057
Latin	-0.4356 ***	-0.2390 ***	-0.1887	0.1963	-0.3603	-0.0633
Other	-0.1207	0.0503	0.2074	0.3506	-0.3552	-0.5209
Age 22+	-1.6054 ***	-1.5797 ***	-1.3465 ***	-0.8834 ***	-0.1476	-1.6476 ***
Momentum	0.7214 ***	0.5762 ***	0.5408 ***	0.3655 *	0.1122	0.4813 **

c. Selection of the number of courses

Fulltime	CT DATA				RI DATA	
	NON-TECHNICAL		TECHNICAL		ALL	
	Male	Female	Male	Female	Male	Female
Black	-0.2116 ***	-0.2472 ***	-0.2891 ***	-0.2803 ***	0.2576	-0.1936
Latin	-0.1332 ***	-0.2624 ***	-0.3073 ***	-0.3319 ***	0.0516	-0.4133 ***
Other	0.1612 ***	0.2748 ***	0.0826	0.4713 ***	0.0782	-0.2423
Age 22+	0.2960 ***	0.2870 ***	0.2255 ***	0.1816 **	0.5524 ***	0.2043
First term	0.1987 ***	0.0558 **	0.4456 ***	0.0856	0.1307	-0.0723
Momentum	0.4092 ***	0.3307 ***	0.4230 ***	0.0559	0.4188 ***	0.2424 **
Cut-point 1	1.1937	1.0257	0.7158	0.6366	1.0031	0.8264
Cut-point 2	3.1405	2.9149	2.3737	2.4208	2.9306	2.5590
Cut-point 3	4.6086	4.3630	3.5839	3.7282	4.2560	3.7493
Cut-point 4	5.4858	5.2546	4.5268	4.5822	5.2500	4.9140
Cut-point 5	6.3041	6.1278	6.1496	6.1113	5.8821	6.3062
Cut-point 6	8.1651	7.5667	7.2912	7.3658	10.0000	7.9171

Part-time	CT DATA				RI DATA	
	NON-TECHNICAL		TECHNICAL		ALL	
	Male	Female	Male	Female	Male	Female
Black	0.4192 ***	0.5947 ***	0.3991 ***	0.3661 ***	0.1139	-0.0009
Latin	0.5015 ***	0.4757 ***	0.3183 ***	0.3560 ***	-0.2262	-0.4180 ***
Other	0.1118 ***	0.1786 ***	0.3749 ***	0.0075	-0.2069	0.2586 *
Age 22+	-0.9141 ***	-0.7692 ***	-0.6970 ***	-0.6582 ***	-0.7472 ***	-0.7285 ***
First term	-0.2423 ***	-0.3138 ***	0.2112 ***	0.0706	0.1816	0.2688 ***
Momentum	0.9655 ***	0.8464 ***	0.7716 ***	0.7245 ***	0.3072 **	0.4177 ***
Cut-point 1	-0.7903	-0.8341	-0.9943	-1.1071	-1.3778	-1.1151
Cut-point 2	1.0003	1.0168	0.8696	0.7075	0.3008	0.6660

d. Course success

	CT DATA				RI DATA	
	NON-TECHNICAL		TECHNICAL		ALL	
	Male	Female	Male	Female	Male	Female
Constatnt	0.7306***	0.9291***	0.6574***	1.1132***	-0.1303**	-0.0164
Black	-0.2147***	-0.3012***	-0.2056***	-0.4607***	-0.3100***	-0.0667
Latin	-0.1550***	-0.1683***	-0.0915**	-0.2547***	0.1439*	0.0160
Other	-0.1454***	-0.1645***	-0.1618***	-0.1814**	-0.1402	-0.1263
Age 22+	0.6728***	0.5121***	0.5127***	0.5258***	0.5576***	0.8838***
First term	0.1429***	0.2242***	0.2579***	0.1399**	0.4960***	0.4895***
Momentum	0.1851***	0.0517***	0.1914***	0.0546	0.6086***	0.5391***
Enroled in 1 more course	0.9735***	0.9938***	1.0931***	1.1092***	1.1929***	1.1289***
Enroled in 2 more courses	1.7427***	1.7417***	1.8459***	1.7410***	1.6576***	1.6627***
Enroled in 3+ more courses	1.9483***	2.0547***	2.1837***	2.2688***	1.9609***	1.9973***

e. Starting population

CT Non-technical	Age at enrolment <22								Age at enrolment 22+							
Male	Initially fulltime student				Initially parttime student				Initially fulltime student				Initially parttime student			
	White	Black	Latin	Other	White	Black	Latin	Other	White	Black	Latin	Other	White	Black	Latin	Other
Term 2000 - 1	1031	160	137	43	653	131	121	35	222	49	39	19	1412	246	207	101
Term 2000 - 2	259	57	36	15	393	104	84	21	93	27	19	15	1059	219	162	86
Term 2001 - 1	1095	169	154	43	607	174	117	46	176	53	33	15	1285	275	210	89
Term 2001 - 2	254	51	36	14	421	103	87	28	99	35	21	12	1017	222	138	70
Term 2002 - 1	1102	179	166	43	686	172	132	40	183	73	36	20	1175	266	202	65
Term 2002 - 2	312	51	30	22	387	110	97	26	91	38	17	7	888	214	172	59
Term 2003 - 1	1228	215	166	64	751	206	162	56	188	60	49	16	1040	273	190	94
Term 2003 - 2	342	55	42	19	436	112	89	31	109	23	25	11	857	187	108	43
Term 2004 - 1	1362	240	184	55	761	190	163	57	184	66	29	11	977	188	184	63
Term 2004 - 2	355	74	51	17	436	114	79	18	125	37	26	8	762	178	117	51
Term 2005 - 1	1504	213	229	78	690	170	147	43	174	52	47	16	871	214	153	63
Term 2005 - 2	338	55	43	16	351	136	83	15	113	37	19	10	707	201	130	37
Term 2006 - 1	1578	234	230	80	643	174	178	39	185	58	44	13	802	175	145	52
Term 2006 - 2	358	82	70	14	330	111	90	24	115	39	25	9	657	156	121	42
Term 2007 - 1	1639	261	250	72	614	213	201	43	176	60	33	21	827	178	159	58
Term 2007 - 2	405	82	71	21	329	91	91	14	123	45	20	10	644	228	181	47
Term 2008 - 1	1805	327	323	70	587	229	208	35	190	73	31	20	775	215	195	59
Term 2008 - 2	437	107	81	19	356	111	98	16	138	48	35	10	703	177	147	48
Term 2009 - 1	1852	364	397	120	650	226	231	68	208	62	56	20	790	220	186	87
Term 2009 - 2	398	110	125	38	372	139	138	37	128	58	47	8	679	200	149	75

CT Non-technical	Age at enrolment <22								Age at enrolment 22+							
Female	Initially fulltime student				Initially parttime student				Initially fulltime student				Initially parttime student			
	White	Black	Latin	Other	White	Black	Latin	Other	White	Black	Latin	Other	White	Black	Latin	Other
Term 2000 - 1	1274	222	196	48	852	226	242	31	318	113	69	24	2525	490	420	176
Term 2000 - 2	272	58	42	13	490	103	120	25	134	35	25	5	1370	273	218	105
Term 2001 - 1	1146	250	253	43	820	196	204	41	272	81	42	27	2193	472	342	149
Term 2001 - 2	238	65	52	11	520	127	110	30	113	53	29	11	1450	334	237	101
Term 2002 - 1	1348	284	270	56	867	246	228	50	273	89	60	27	2155	489	390	134
Term 2002 - 2	343	90	75	20	512	141	151	24	161	62	31	25	1401	360	278	93
Term 2003 - 1	1484	310	305	67	909	254	241	50	325	148	88	31	2156	523	418	151
Term 2003 - 2	355	102	78	15	503	138	130	22	136	67	28	17	1442	405	273	113
Term 2004 - 1	1699	334	304	73	966	274	265	58	315	124	57	43	1991	420	419	144
Term 2004 - 2	370	100	102	18	523	173	145	33	144	78	38	14	1310	305	276	100
Term 2005 - 1	1791	337	377	88	864	267	265	47	272	104	77	31	1818	411	367	131
Term 2005 - 2	387	115	100	15	438	156	154	25	126	61	29	11	1249	294	257	96
Term 2006 - 1	1837	332	398	72	756	231	238	47	293	92	73	29	1763	358	366	125
Term 2006 - 2	367	140	124	20	399	102	135	27	139	62	44	13	1108	275	257	97
Term 2007 - 1	1806	380	365	79	811	247	264	46	259	104	63	19	1701	360	358	132
Term 2007 - 2	397	118	117	21	444	109	122	27	114	69	37	16	1132	278	256	78
Term 2008 - 1	2024	425	460	86	732	220	248	42	266	116	52	22	1605	367	391	139
Term 2008 - 2	438	155	132	30	401	132	144	21	130	74	45	8	1224	300	269	86
Term 2009 - 1	2014	473	609	156	880	274	347	89	302	120	92	29	1668	410	441	181
Term 2009 - 2	418	143	155	52	425	139	161	30	133	72	40	19	1233	308	314	138

CT Technical	Age at enrolment <22								Age at enrolment 22+							
Male	Initially fulltime student				Initially parttime student				Initially fulltime student				Initially parttime student			
	White	Black	Latin	Other	White	Black	Latin	Other	White	Black	Latin	Other	White	Black	Latin	Other
Term 2000 - 1	286	41	35	23	80	21	24	4	87	23	11	15	221	47	37	19
Term 2000 - 2	43	12	8	5	38	11	9	2	21	7	8	4	120	26	20	13
Term 2001 - 1	240	32	36	13	76	21	29	7	59	8	3	4	183	35	28	13
Term 2001 - 2	47	7	5	4	42	8	10	3	24	7	4	3	112	26	14	11
Term 2002 - 1	258	36	40	18	91	19	24	11	45	23	10	7	143	32	17	9
Term 2002 - 2	56	13	7	5	36	16	12	5	33	10	6	4	115	18	16	3
Term 2003 - 1	294	56	34	29	87	24	27	9	69	16	7	8	123	31	14	9
Term 2003 - 2	49	5	14	4	28	10	10	2	31	14	7	3	106	20	18	5
Term 2004 - 1	279	39	50	17	78	27	29	7	55	17	13	7	102	21	23	6
Term 2004 - 2	49	13	4	6	37	10	10	6	36	8	1	4	78	23	14	7
Term 2005 - 1	340	38	57	19	83	23	32	9	45	9	7	8	119	25	20	9
Term 2005 - 2	72	11	13	2	41	6	14	6	38	4	2	5	84	22	19	7
Term 2006 - 1	306	42	62	18	73	25	26	12	61	20	14	3	132	32	18	12
Term 2006 - 2	50	14	8	5	31	7	9	6	39	8	2	5	69	20	10	8
Term 2007 - 1	296	61	66	12	74	28	44	9	65	22	10	6	94	29	15	11
Term 2007 - 2	63	15	9	7	41	11	15	4	35	10	4	3	77	24	13	5
Term 2008 - 1	345	53	67	26	90	27	37	13	74	21	18	6	105	39	31	11
Term 2008 - 2	63	17	14	5	28	15	9	2	36	7	7	8	83	21	19	8
Term 2009 - 1	322	58	83	32	90	25	41	13	88	12	9	12	138	14	20	15
Term 2009 - 2	45	13	14	6	32	16	7	3	42	11	11	9	63	18	18	7

CT Technical	Age at enrolment <22								Age at enrolment 22+							
Female	Initially fulltime student				Initially parttime student				Initially fulltime student				Initially parttime student			
	White	Black	Latin	Other	White	Black	Latin	Other	White	Black	Latin	Other	White	Black	Latin	Other
Term 2000 - 1	52	16	14	2	28	8	19	10	32	7	4	9	100	15	14	9
Term 2000 - 2	8	3	3	2	7	8	7	2	8	1	1	3	44	7	6	4
Term 2001 - 1	53	8	14	8	29	11	5	9	26	5	1	5	63	19	10	5
Term 2001 - 2	12	7	2	1	18	3	2	2	13	5	1	0	50	16	6	8
Term 2002 - 1	61	15	17	6	27	12	17	4	32	9	5	6	75	21	17	4
Term 2002 - 2	9	2	2	1	12	3	4	1	15	5	2	2	50	8	9	7
Term 2003 - 1	50	18	11	3	21	11	14	3	29	3	6	7	78	16	15	7
Term 2003 - 2	11	3	2	1	8	6	5	1	15	6	4	0	52	25	7	6
Term 2004 - 1	57	17	12	4	26	8	11	3	24	7	5	2	77	26	13	8
Term 2004 - 2	16	6	3	1	15	5	3	2	7	3	6	0	42	11	15	3
Term 2005 - 1	82	30	13	7	32	5	10	2	29	12	3	5	96	29	14	9
Term 2005 - 2	15	7	2	1	7	6	4	1	11	4	2	0	51	9	12	3
Term 2006 - 1	83	27	26	2	27	9	11	1	40	13	8	2	100	29	12	8
Term 2006 - 2	18	16	4	0	18	4	8	0	9	6	3	2	67	22	14	7
Term 2007 - 1	108	34	28	13	32	11	14	4	30	12	3	2	103	21	15	6
Term 2007 - 2	27	7	4	2	21	7	13	2	13	6	2	1	53	19	12	7
Term 2008 - 1	107	38	28	7	28	13	11	5	33	10	6	5	89	15	12	9
Term 2008 - 2	5	2	3	0	1	2	2	0	14	1	1	1	20	4	5	0
Term 2009 - 1	56	11	12	6	14	10	3	5	14	5	0	0	42	7	4	4
Term 2009 - 2	5	1	6	1	6	4	4	2	7	1	3	1	26	3	6	4

RI All	Age at enrolment <22								Age at enrolment 22+							
Term 2005 -1	Initially fulltime student				Initially parttime student				Initially fulltime student				Initially parttime student			
	White	Black	Latin	Other	White	Black	Latin	Other	White	Black	Latin	Other	White	Black	Latin	Other
Male	570	49	64	46	82	32	43	14	27	6	6	2	46	20	22	10
Female	653	50	75	55	115	33	69	31	47	8	10	5	113	30	60	22

Annex 2: Model download and user guide

The presented model can be downloaded at:

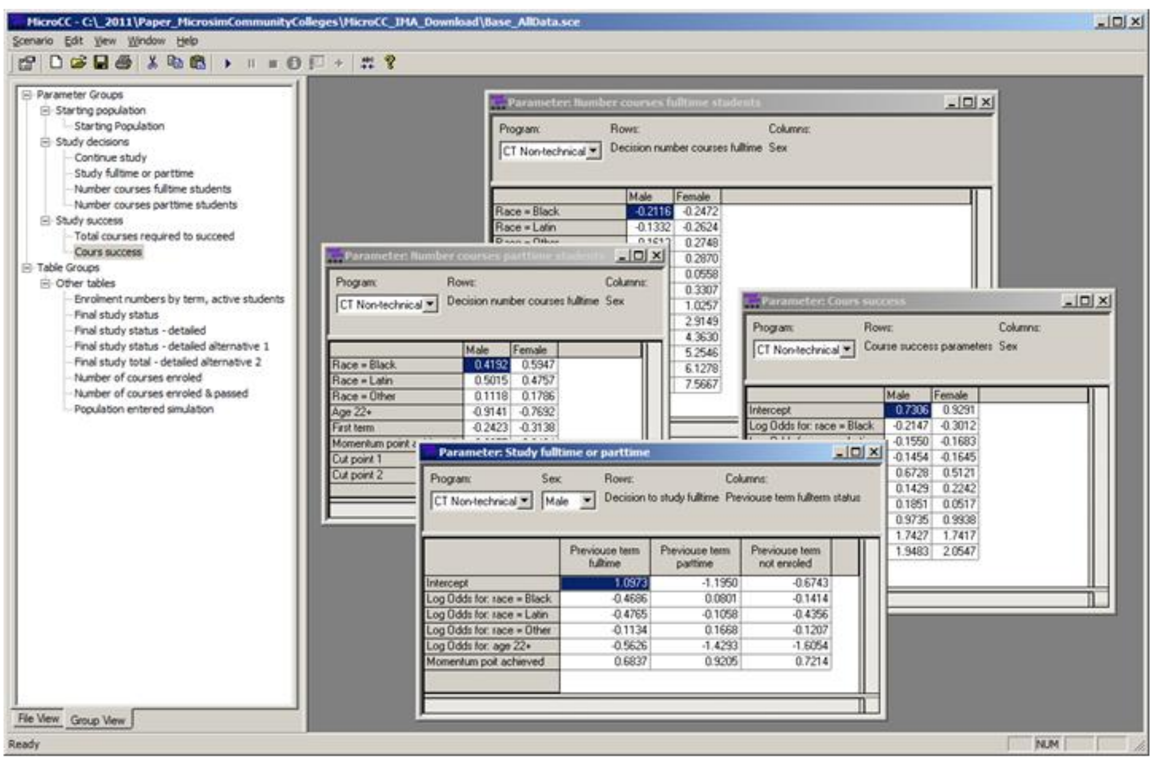
http://www.spielauer.ca/MicroCC_IMA_Download.rar

Running the model requires the installation of "Modgen prerequisites" from Statistics Canada. This software can be freely downloaded at:

http://www.statcan.gc.ca/microsimulation/modgen/download-telecharger-eng.htm

Like all Modgen applications, MicroCC has an attractive visual user interface which allows easy scenario creation and management and access to all model output tables. The help system includes a documentation of Modgen as well as a detailed technical documentation of the MicroCC application. The following gives a brief overview of the basic steps required for a model run:

Step 1: Open a scenario: Scenario / open



Step 2: Before changing parameters it is advised to save the scenario under a new name Scenario / save as

Step 3: All parameter tables can be accessed easily by selection a table in the navigation window on the left side of the application.

Step 4: Scenario settings can be set and changed in Scenario / Settings. The most important scenario parameter is the population size; a typical run is 1 million cases. If output is to be produced for smaller population groups, e.g. a single cohort of a single program, scenario size can be increased for increased precision.

Step 5: Scenario / run starts the simulation. Simulating 1 million cases typically takes around 30 seconds

Step 6: Simulation results are presented in a set of tables which can be accessed like parameter tables. Right-clicking a table opens a context menu allowing to set e.g. decimal places, or to display coefficients of variation for each table value.