A Model for Estimating Time to Degree in Colleges of Agriculture and Natural Resources: A University of Minnesota Case Study

A Selected Paper

Presented At

The Annual Meeting of the American Agricultural Economics Association

Orlando, Florida

July 27-30, 2008

Why Time-to-degree is Important

According to the California Postsecondary Education Commission study, "the timely movement of students through the postsecondary educational pipeline is an important facet of the transfer function. An effective transfer pipeline enables larger numbers of students to utilize the postsecondary education system. An efficient student transfer system performs this function in a timely manner, saving money for the public and the students by reducing outlays for education and improving the ability of students to recoup costs by timely entry into employment. " This statement underscores the need for higher education institutions to make the best use of institutional resources by moving students through their respective educational programs at a time when tuition rates are at record highs; this is an issue of accountability. The federal government has also taken an interest by creation and support of the IPEDS Graduation Rate Survey. Several states such as Florida, Louisiana, Ohio, South Carolina and Virginia have linked graduation rates to performance funding initiatives. Ohio has recently made available to state universities, Success Challenge Funds, which reward schools for the timely completion of degrees.

This concern for efficiency has also manifested itself in a focus on ways to improve retention of students. The retention issue is related to time-to-degree in that there is a tradeoff between

the length of time to complete an academic program and the decision to drop out of the program. Research conducted in Illinois shows that this is an inverse relationship. In other words, the students who take longer to complete a program, do not drop out of a program. It follows that shortening time-to-degree may also decrease the retention of students.

One of the main principles in time-to-degree is cycle efficiency. The analysis of flow or throughput is an essential element in this form of efficiency. Paradigms such as Six Sigma also relate to flow efficiency in that rework is eliminated by low failure rates (defects). In this way, the rate of defect is equivalent to lack of retention of students. Once retained, it is then necessary to move the student quickly through the academic program. By including full summer enrollment, some programs are advocating graduation in less than four years; this philosophy is similar to the Lean Manufacturing system. The main principle of the Lean Manufacturing system is analysis of throughput and factors which prevent or slow down movement through a system.

Review of literature

A number of higher educational institutions have studied time-to-degree rates of completion. The California Postsecondary Education Committee compiled a report which analyzed time-to-degree information for community college students who transfer to the University of California and California State University (CSU) systems. This report provides a baseline measurement and initial point for measurement of transfer student time-to-degree.

Regarding this transfer student population, the report revealed that about 48.5% of the transfers to the CSU system graduated in three years or less. Correspondingly, about 73.1% of the transfers to the University of California system graduated in three years or less.

According to the California Postsecondary Education Committee report, the major factors affecting time-to-degree are:

1. Course–taking decisions by students
2. Increases in student fee levels and costs of attendance
3. Changes in declared majors and deficiencies in prior academic coursework
4. The states economic condition (recessions, etc)
5. Personal choice

Major national studies of Time to Baccalaureate Degree by Bound, Lovenheim, and Turner utilize longitudinal studies of high school classes of 1972 and the NELS -1988 classes. Using this national data, it is reported that the college completion rate has dropped from 51.1% to 45.3% between these two survey dates. The variables identified in this survey analysis were:

1. Changes in student characteristics- the issue of quality and quantity of students
2. Resources per student and institutional constraints
3. Student responses to increases in college costs- need to work

Bowling Green State University (2003) completed a comprehensive model of time-to-degree attainment which repeated and enlarged upon a year 2000 study. The National Center for Educational Statistics High School and Beyond survey indicates that the de facto mean for time-to-degree is 57 months. The increased length to degree is attributed to more students attending part-time, transferring between institutions, working while in school, needing remedial coursework; these are student-related factors. Also identified were institutional characteristics such as quality of advising, insufficient course availability and expansion of degree requirements.

Other authors (Adelman, Belcheir, Duby and Schartman, Knight, Lam, Noxel and Katunich, Oklahome Regents for Higher Education report and Volkweind and Lorang) have identified factors such as stopout behavior, course withdrawals, course load per term, receipt of incompletes, grade point averages in freshman years and later, gender, first generation students, ACT/SAT scores, out-of–state origin, age, family income, and presence of financial aid. Separate studies of the influence of financial aid reported differences in the form of this aid with significant differences reported between grant and loan support.

A number of variables in the Bowling Green study were regressed on the dependent variables time elapsed from first enrollment and actual semesters enrolled. The study concluded that average student credit hours enrolled per semester, student credit hours transferred, simultaneous high school and college enrollment resulted in decreased time to degree. Correspondingly, total student credit hours earned, coop education course enrollment (internships, etc.), and number of courses repeated tended to increase time to degree. Other

information from internal surveys indicate that changing majors, working while enrolled, and lack of class availability were also factors in time to degree.

Multivariate Models for Predicting Time-to- Degree

The most common predictive model of Time-to-Degree is ordinary linear regression, although some studies have utilized profit analysis for different groups. The dependent variable is usually two fold. One dependent variable is the number of semesters elapsed from first enrollment to final degree award. Another dependent variable is the number of semesters actually enrolled from the beginning to the end of the degree program. The difference is the number of semesters in which the student has stopped out or disenrolled.

The independent variables are chosen from demographic, academic ability, whether students receive financial aid, whether students transfer or start at the institution, scholastic progress (courses dropped or retaken, changes of major), the need for remediation and academic ability. In previous studies, high school GPA and first year college GPA, course load, financial aid, parent's educational level, enrollment in summer sessions or special learning communities has explained over 50% of the variation in progress toward a baccalaureate degree.

The CFANS Predictive Model

The following variables were used to predict the time-to –degree of University of Minnesota students. Two different regressions for transfer students or new advanced standing students (NAS) and new high school enrollees (NHS) were run. The dependent variables were: semesters elapsed from initial enrollment and actual number of semesters enrolled. The independent variables were: cumulative GPA, total credits at graduation, GPA in first year, courses withdrawn or repeated-number, gender, summer sessions enrolled, average ACT scores, average high school rank, courses repeated and other variables unique to the University of Minnesota.

The model may be written as:

$$Snis = f(Dv, SCv, PGv, CSv, WV, FINv, OTHv)$$

Where: Sv= Either semesters enrolled or semesters elapsed from first registration to graduation

Dv= Demographic variables such as age, gender, parents education, etc

SCv= Scholastics/academic variables such as H.S GPA, ACT & SAT scores ,HS rank

PGv= Programmatic choice of major (0,1)

CSv= Coursework choices, total credits per semester, total credits at graduation; courses

Withdrawn or repeated, summer enrollment (0,1), learning community participant(0,1)etc

Wv= whether students worked (0,1)

FINv= whether students received financial aid and the form of that aid in grants or loans(0,1)

OTHv= other unspecified variables.

The model for NAS students is the same as above with two dependent variables (number of semesters enrolled and number of semesters elapsed from first registration to graduation). One difference in the two types of regressions for NHS and NAS is that the number of semesters required for graduation will be significantly less in the NAS students; in fact, they may be less than one half of that of NHS students. The number of credits transferred and, indeed, the acceptance of those credits will have a major influence on the time required to graduate. If the NAS student follows a prescribed 2+2 program in the transfer institution, the acceptability of credits should be insured. If they are not insured, the acceptance of courses into the new programs may be varied. The State of Minnesota has sponsored a web-based

transfer guide which lists all courses accepted at the final institution receiving the credits. This procedure allows advisors and others to plan for students taking these selected courses. One of the authors just completed a reverse transfer for a student taking final credits at another institution to be transferred as elective credits.

Results of Multivariate Analysis

The multivariate analysis includes several variables that describe students' background, ethnicity, quality indicators of incoming students and much more. Many of the variables in the model are listed below in the form of a database table. This is a sample of the total; however, they are listed here to offer a general overview.

KPI_Demographics Table

Kpi_demo_id	Primary key
Kpi_Main_id	Foreign key
Acad_prog	College student enrolled
Sex	Gender of student
Ethnic_Group	Ethnic group of student
BirthDate	Birth date of student
Citizenship	Country student originated from
Residency	Residency status of student
PSEOA	Post secondary educational opportunity
Home_Loc_cd	Home county code
Home_Loc_Descr	Home county description
City	Home city

State	Home state
Postal	Home zip code
HomeCounty	Home county from demographic database
HomeZipPopulation	Total population of home zip code from demographic database
CityPopulationEst	Total city population estimate from demographic database
CBSA_Type	Indicates metro, rural or N/A

Data Summary

Specify data elements in the model used for entering new high school students includes those listed below.

Data Elements Included In Analysis

- Semesters attended (dependant variable)
- GPA at time of degree
- Composite ACT score
- High school rank
- Total cumulative credits at graduation
- Cumulative GPA at the end of the first year
- Ratio of courses enrolled to completed
- Courses failed or withdrawn from
- Summer sessions enrolled

Descriptive Statistics

Data Element	Mean	Std. Deviation	N
semesters_attended	9.40	2.77	684
GPA_DEGREE	3.180	0.401	684
comp_act_score	24.09	3.62	684
hs_rank_pct	77.48	15.33	684
Tot_Cumulative	127.08	17.67	684
FirstYear_GPA	3.041	0.508	684
Ratio of Courses Taken	0.972	0.036	684
Courses Failed or Withdrawn	1.24	1.58	684
SummerSessionsEnrolled	0.81	0.90	684

Model Summary

Mode	R*	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.594	0.353	0.345	2.242

* Predictors: (Constant), SummerSessionsEnrolled, comp_act_score, Ratio of Courses Taken, Tot_Cumulative, hs_rank_pct,

FirstYear_GPA, GPA_DEGREE, Courses Failed or Withdrawn
** Dependent Variable: semesters_attended

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients
	B	Std. Error	Beta
(Constant)	-13.537	4.888	
GPA_DEGREE	0.248	0.440	0.036
comp_act_score	-0.014	0.028	-0.018
hs_rank_pct	-0.012	0.007	-0.066
Tot_Cumulative	0.036	0.005	0.228
FirstYear_GPA	-0.283	0.329	-0.052
Ratio of Courses Taken	18.453	4.932	0.240
Courses Failed or Withdrawn	0.616	0.115	0.351
SummerSessionsEnrolled	1.279	0.102	0.416

* Dependent Variable:
Semesters_attended

Specify data elements used for all transfer students includes those listed below.

Data Elements Included In Analysis

- Semesters attended (dependant variable)
- GPA at time of degree
- Credits attempted
- Credits completed
- Total cumulative credits at graduation
- Cumulative GPA at the end of the first year
- Ratio of courses enrolled to completed
- Gender and ethnicity
- Courses failed or withdrawn from
- Summer sessions enrolled

Descriptive Statistics

Data Element	Mean	Std. Deviation	N
semesters_attended	6.31	2.58	1482
GPA_DEGREE	3.115	0.408	1482
UnitsAttempted	77.05	32.37	1482
UnitsCompleted	74.09	30.41	1482
Tot_Cumulative	138.95	21.66	1482
FirstYear_GPA	3.05	0.45	1482
Courses Failed or Withdrawn	1.38	1.98	1482
Gender	1.545	0.527	1482
Ethnicity	1.507	1.448	1482
SummerSessionsEnrolled	0.98	0.90	1482
Ratio of Courses Taken	0.97	0.05	1482

Model Summary

Mode	R*	R Square	Adjusted R Square	Std. Error of the Estimate
1	.792a	0.628	0.625	1.579

* Predictors: (Constant), Ratio of Courses Taken, Ethnicity, Tot_Cumulative, UnitsCompleted, Gender, FirstYear_GPA, SummerSessionsEnrolled, Courses Failed or Withdrawn, GPA_DEGREE, UnitsAttempted

** Dependent Variable: semesters_attended

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	-0.992	2.013		-0.493	0.622
GPA_DEGREE	0.296	0.246	0.047	1.206	0.228
UnitsAttempted	0.085	0.021	1.061	4.028	0.000
UnitsCompleted	-0.035	0.022	-0.407	-1.582	0.114
Tot_Cumulative	0.015	0.002	0.124	7.568	0.000
FirstYear_GPA	-0.467	0.214	-0.082	-2.177	0.030
Courses Failed or Withdrawn	0.030	0.032	0.023	0.931	0.352
Gender	0.244	0.080	0.050	3.059	0.002
Ethnicity	-0.013	0.029	-0.007	-0.460	0.646
SummerSessionsEnrolled	0.656	0.050	0.229	13.096	0.000
Ratio of Courses Taken	0.781	2.043	0.016	0.382	0.702

* Dependent Variable: semesters_attended

Conclusion

Our conclusions thus far as they relate to factors affecting graduation rates for entering new high school students point to ACT scores, high school rank and first year GPA as factors positively influencing time to degree. As seen from the above analysis these factors show a positive impact on the time it takes for a entering high school student to complete their degree based on semesters enrolled.

Similarly we see a correlation with average first year GPA to length of program for transfer students as well. In addition the ratio of courses taken to completed shows a positive impact as well. Which is what one might expect given the fact that a lower success rate in courses attempted versus completed increases the number of courses students must re-take to complete their degree.

It must be emphasized that this is a beginning effort and much more work is needed to more clearly understand the factors that affect time to degree for both new high school students as well as transfer students. Data needs to be analyzed that explores possible relationships between financial aid, college cohorts such as student learning communities and recreational sports involvement in addition to other demographic factors.

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