Enrollments in the Proposed Master's Degree Program in Community and Economic Development: Predictions Based on a New Product Diffusion Model

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Abstract

The purpose of this study is to inform a university management about the likely demand or enrollment in a new, community-development graduate program. Since the degree is a new product, we utilized a diffusion model to forecast enrollments. The parameters of the model were calibrated using analogs. The results suggest that the total enrollment in the program would start slowly, with around 2 to 4 students in the first two years, and reach a maximum of 22 to 37 students within five years. More importantly, the demand for the proposed degree program would be independent of student enrollment in related disciplines such as economics, geography, and sociology.

Introduction

A medium-size public university in Illinois (hereafter, the focal university), is planning to offer a master's program in community and economic development. This initiative comes at a time when the lackluster job market in the nation is fuelling enrolments in graduate programs (Whitlock, 2008). For instance, a recent Bureau of Labor Statistics news release states that the Chicago-Joliet-Naperville region shed approximately 160, 000 jobs during the February 2009–February 2010 time period (www.bls.gov/opub/ted/2010/ted_20100412.htm). As a correlate, the focal university's graduate program registered a 6% increase in enrolments from Spring 2009 to Fall semester 2009 (see http://www.wiu.edu/irp/enrollments/index.php#2). The predictions are for the increases to sustain in the coming years (National Center for Education Statistics, 2009; see Appendix 1).

Table 1 compares the enrollment trends in master's program at the focal university with all the other Illinois universities. Note the double-digit growth rate in enrollment for the focal university during the period 2006 to 2008.

Table 1. Number of Enrollees in Master's Program – 2006 to 2008

Year	**Focal University**	**All Other Universities**
2006	526	101, 447
2007	583	104, 931
2008	608	111, 017
% Δ (2006 to 2008)	15	9

Source: IBHE, http://www.ibhe.org/InstitutionProfiles/Institutions.aspx

In the following pages, we utilize a mathematical model of new-product diffusion to forecast the enrollment numbers in the proposed master's program in community and economic

development. Section 2 describes the model and specifies the conditions or assumptions that guided the model-building process. Section 3 presents the results, and section 4 discusses the implications for the degree program.

The New-Product Diffusion Model

As mentioned earlier, the objective is to forecast the number of enrollees in the master's program. The theory behind the model is that in a population, for any given new product, there exists a certain group of potential customers, called innovators, who will find it desirable to adopt the new product without regard to who else has adopted it. Others in the population, however, will adopt based on the number that have adopted before them. Therefore, the market growth of a new product depends on the proportion of innovators in a market, the rate at which they adopt the new product, and the relationship between the number of adopters at any time and the number of imitators (see Rogers, 1983 for more on the theoretical basis of the model).

Mathematically,

$$\frac{\partial N(t)}{\partial t} = g(t)\,[\,\bar{N} - N(t)] \qquad (1)$$

where, g(t) is the diffusion coefficient which is an ~ f(N(t)); $\bar{N}$ = number of potential adopters, and $N(t)$ = cumulative adopters at time *t*

Rewriting Eq. 1 using $g(t) = \alpha_0 + \alpha_1 N(t)$ results in:

$$\frac{\partial N(t)}{\partial t} = [\alpha_0 + \alpha_1 N(t)]\,[\,\bar{N} - N(t)] \qquad (2)$$

where, α_0 is the innovation coefficient, and α_1, the imitation parameter.

Note that when $\alpha_0 = 0$, Eq. (2) reduces to;

$$\frac{\partial N(t)}{\partial t} = \alpha_1 N(t)\,[\,\bar{N} - N(t)]$$

Similarly, when $\alpha_1 = 0$, Eq. (2) becomes;

$$\frac{\partial N(t)}{\partial t} = \alpha_0[\,\bar{N} - N(t)].$$

To solve for N(t) ,the cumulative adopters at time *t*, we integrate Eq. 2, the first order differential equation with respect to *t*:

that is, $\int_0^t \frac{\partial N(t)}{\partial t}$ =

$$\frac{\bar{N} - \{\alpha 0\,[\,\bar{N} - N(0)]/[\,\alpha 0 + \alpha 1\,N(0)]\}e^{[-(\alpha 0 + \alpha 1\,\bar{N})]\,t}}{1 + \{\alpha 1\,[\,\bar{N} - N(0)]/[\,\alpha 0 + \alpha 1\,N(0)]\}\,e^{[-(\alpha 0 + \alpha 1\,\bar{N})]\,t}} \qquad (3)$$

Again, when $\alpha_0 = 0$, only imitation matters:

$$N(t) = \bar{N}/[1 + \frac{[\bar{N}-N(0)]}{N(0)}\, \alpha_1 e^{-\alpha 0 t}\, \bar{N}t)]$$

Similarly, when $\alpha_1 = 0$, innovation accounts for all of the adoption:

$$N(t) = \bar{N}(1 - e^{-\alpha 0 t})$$

Model Calibration

To use the model for the proposed degree, the parameters appropriate for the degree program should be obtained and input into Eq. 3. This could be done either using managerial judgment or an analog product.

Consider the judgmental approach, "jury-of-stakeholders method" (Armstrong, 2001). The stakeholders: faculty, administrators, students, and employers, need to be interviewed in one or more group settings to obtain judgmental, parameters estimates. There are several problems with this approach. First, it is difficult, if not impossible to convene a meeting that involves all relevant stakeholders. Secondly, it is difficult to decide on "weights" for the groups; should we place more importance to the employer or faculty responses? Finally, groupthink, where one or more stakeholders dominate the discussions, could become an issue. Procedures such as DELPHI could be used to dampen or remove groupthink, but they are costly to implement; moderation of DELPHI discussions require specially trained professionals.

Mahajan, Muller, and Bass (1990) posit that one way to overcome the problems of judgmental methods is to assess whether the new product is analogous to a product for which the parameters are known and published. Translated to the problem at hand, if an analog exists, then its parameters may be used to obtain an enrollment forecast for the proposed degree program. Research conducted by Wright, Upritchard, and Lewis (1997) provides such an analog. Specifically, based on the findings that dealt with an educational innovation (an accelerated educational program), we set the model parameters as follows:

$\alpha_0 = .0034$, and

$\alpha_1 = .6186$

As regards market potential, our interest is on the "available" market: defined as number of students who have interest in the degree and access to it. The Fall 2008 enrolments in master's programs in economics (general), geography, and sociology, in Illinois public universities, is used as a proxy indicator (Appendix 2).

Results

Table 2 shows the results of the diffusion-model run. It suggests that enrolments in the program could range from a low two students in 2011, to high 28 students in 2015, five years after the launch.

This model is a conservative estimate of the market demand for the degree since it is assumed that the market potential is a "constant" in spite of the contradictory, growth evidence depicted in Appendix 1.

Table 2. A Conservative Estimate of Market Demand for the Degree (units = # of students)

Period / Forecasting Scenarios	Educational innovation	Market Potential
Total Market Potential	**525**	
Parameter p	**0.003**	
Parameter q	**0.619**	
0	0.00	525.00
1	1.79	525.00
2	4.66	525.00
3	9.29	525.00
4	16.69	525.00
5	28.42	525.00

In order to gain additional insights about the market demand, we relaxed the constant market potential assumption. Furthermore, we used two other analogs for the degree: solar energy (BTU generated), and ultrasound imaging adoption by hospitals. Given tough, global economic conditions, we believe that it is a matter of time before communities start employing graduates trained in community and economic development, and this "adoption" will follow a diffusion path similar to the analogs. Figure 1 shows the likely market penetration for the degree under this scenario and Table 3 highlights the predictions.

Figure 1. Probable Market Penetration – Master's in Community and Economic Development

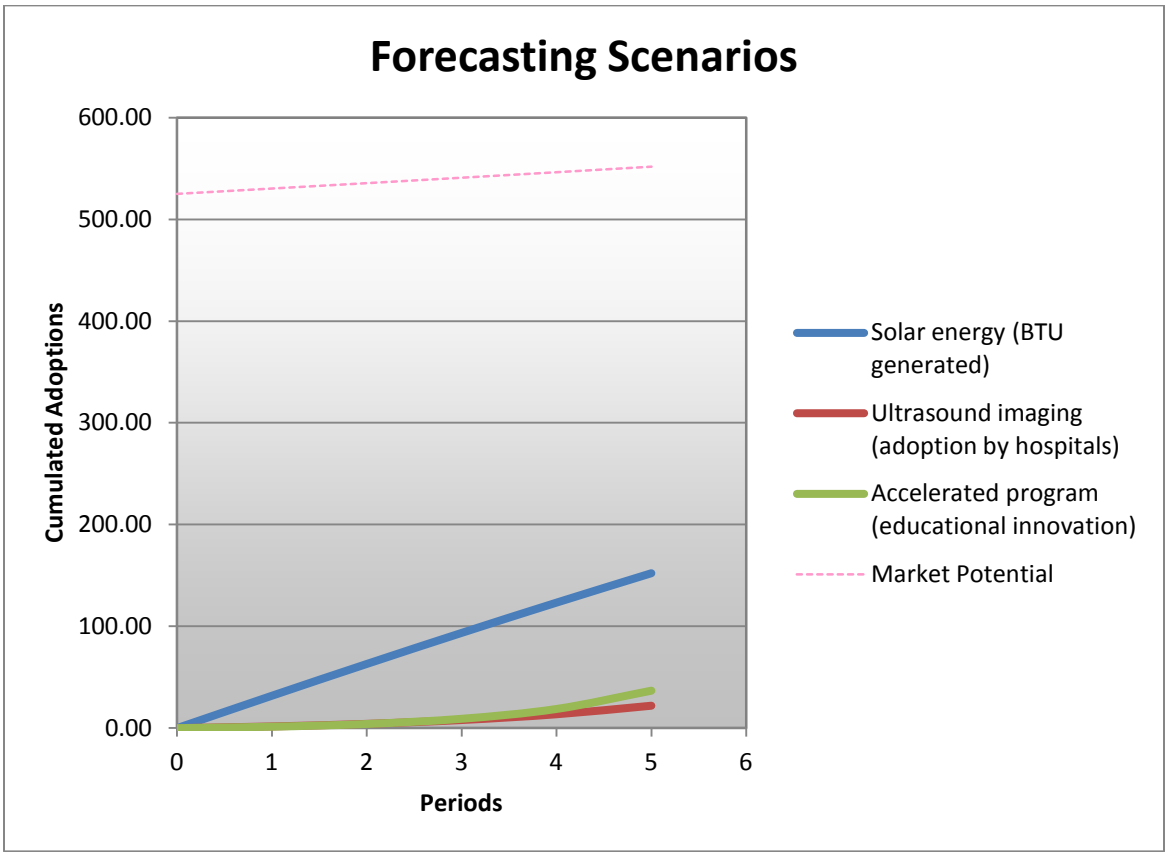

Table 3. Scenario Analysis: Probable Market Penetration

Period / Forecasting Scenarios	Solar energy (BTU generated)	Ultrasound imaging (adoption by hospitals)	Educational innovation	Market Potential
Total Market Potential	**525**	**525**	**525**	
Parameter p	**0.060**	**0.003**	**0.003**	
Parameter q	**0.033**	**0.506**	**0.913**	
0	0.00	0.00	0.00	525.00
1	31.82	1.65	1.39	530.25
2	63.03	4.16	4.05	535.55
3	93.54	7.92	9.13	540.91
4	123.26	13.55	18.74	546.32
5	152.13	21.92	36.67	551.78

Discussion

A normative prescription in forecasting is to develop multiple forecasts that depend on different sources of information. Convergence of results, should instill a sense of confidence in the resulting forecasts. Student enrollments in the proposed master's degree were assessed using solar energy generation, ultrasound imaging and an educational innovation as analogs. As shown in Figure 1, the forecasts are reasonably close for ultrasound and educational innovations, when projected five years into the future.

The results suggest that total enrollment in the program would start slowly, with around 2 to 4 students in the first two years, and reach a maximum of 22 to 37 students within five years. These numbers, we believe, are not draw and cannibalization estimates. In other words, the demand for the proposed degree program would be independent of student enrollment in related disciplines such as economics, geography, and sociology.

It could be useful for the focal university to obtain market-based assessments of market potential. However, such a study could be time consuming and may cost upwards of $15, 000 to implement.

Conclusion

The forecasting exercise suggests that the potential degree could focus on benefits such as small class sizes, and interaction with academics, as "selling" points. It is now up to the developers of the degree program to assess its financial viability.

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Appendix 1

Total graduate and first-professional enrollment in degree-granting institutions, with projections, by sex and attendance status: 1976–2018

[In thousands]

Fall of year	Total	Graduate					First-professional				
		Total	Male	Female	Full-time	Part-time	Total	Male	Female	Full-time	Part-time
1976	1,578	1,333	715	619	464	870	244	190	54	220	24
1977	1,569	1,318	700	617	473	845	251	191	60	226	25
1978	1,576	1,319	688	631	472	846	257	192	65	233	24
1979	1,572	1,309	669	639	476	833	263	193	70	239	24
1980	1,622	1,344	675	669	485	859	278	199	78	251	26
1981	1,617	1,343	674	669	484	859	275	193	82	248	26
1982	1,601	1,322	670	653	485	838	278	191	87	252	26
1983	1,619	1,340	677	663	497	843	279	188	90	250	29
1984	1,624	1,345	672	673	501	844	279	185	94	250	29
1985	1,650	1,376	677	700	509	867	274	180	94	247	28
1986	1,706	1,435	693	742	522	913	270	174	97	246	25
1987	1,720	1,452	693	759	527	925	268	170	98	242	27
1988	1,739	1,472	697	774	553	919	267	167	100	241	26
1989	1,796	1,522	710	811	572	949	274	169	106	248	27
1990	1,860	1,586	737	849	599	987	273	167	107	246	28
1991	1,920	1,639	761	878	642	997	281	170	111	252	29
1992	1,950	1,669	772	896	666	1,003	281	169	112	252	29
1993	1,981	1,688	771	917	688	1,000	292	173	120	260	33
1994	2,016	1,721	776	946	706	1,016	295	174	121	263	31
1995	2,030	1,732	768	965	717	1,015	298	174	124	266	31
1996	2,041	1,742	759	983	737	1,005	298	173	126	267	31
1997	2,052	1,753	758	996	752	1,001	298	170	129	267	31
1998	2,070	1,768	754	1,013	754	1,014	302	169	134	271	31
1999	2,110	1,807	766	1,041	781	1,026	303	165	138	271	33
2000	2,157	1,850	780	1,071	813	1,037	307	164	143	274	33
2001	2,212	1,904	796	1,108	843	1,061	309	161	148	277	32
2002	2,355	2,036	847	1,189	926	1,109	319	163	156	286	33
2003	2,431	2,102	867	1,235	985	1,117	329	166	163	296	33
2004	2,491	2,157	879	1,278	1,024	1,133	335	168	166	302	33
2005	2,524	2,186	877	1,309	1,047	1,139	337	170	167	303	34
2006	2,575	2,231	887	1,344	1,077	1,154	343	174	170	309	34
2007	2,644	2,294	910	1,383	1,112	1,181	351	178	173	317	34

Projected											
2008	2,694	2,339	956	1,382	1,119	1,220	355	184	171	319	36
2009	2,733	2,369	968	1,401	1,152	1,217	364	188	176	328	36
2010	2,741	2,376	972	1,404	1,158	1,218	366	189	177	330	36
2011	2,776	2,405	980	1,425	1,176	1,229	371	190	181	335	36
2012	2,830	2,450	992	1,458	1,205	1,245	379	193	186	343	36
2013	2,899	2,509	1,006	1,502	1,244	1,265	390	197	194	353	37
2014	2,953	2,555	1,020	1,534	1,268	1,286	398	201	197	360	37
2015	3,001	2,596	1,031	1,564	1,291	1,304	405	203	201	367	38
2016	3,044	2,633	1,041	1,592	1,312	1,321	411	206	205	373	38
2017	3,091	2,674	1,051	1,622	1,335	1,338	418	208	209	379	39
2018	3,125	2,703	1,060	1,643	1,349	1,354	422	210	212	383	39

SOURCE: U.S. Department of Education, National Center for Education Statistics (NCES). (2009). *Digest of Education Statistics, 2008* (NCES 2009-020), tables 206 and 207, and (2009). U.S. Department of Education, NCES, Higher Education General Information Survey (HEGIS), "Fall Enrollment in Colleges and Universities" surveys, 1976–1985, and Integrated Postsecondary Education Data System (IPEDS), "Fall Enrollment Survey" (IPEDS-EF:86–99), and Spring 2001 through Spring 2008; and Enrollment in Degree-Granting Institutions Model, 1980–2007.

Appendix 2: Fall 2008 Enrollments – Illinois Public Universities

Institution	Program Name	Total
Chicago State University	M.A. in Geography	14
Northern Illinois University	M.S. in Geography	35
Southern Illinois University Carbondale	M.S. in Geography and Environmental Resources	24
Southern Illinois University Edwardsville	M.A. and M.S. in Geographical Studies	30
U of I at Chicago	M.A. in Environmental and Urban Geography	4
U of I at Urbana/Champaign	M.A. and M.S. in Geography	20
Western Illinois University	M.A. in Geography	20
	GRAND TOTAL:	**147**

Institution	Program Name	Total
Eastern Illinois University	M.A. in Economics	19
Illinois State University	M.A. and M.S. in Applied Economics	28
Northern Illinois University	M.A. in Economics	11
Southern Illinois University Carbondale	M.A. and M.S. in Economics	17
Southern Illinois University Edwardsville	M.A. and M.S. in Economics and Finance	32
U of I at Chicago	M.A. in Economics	22
U of I at Urbana/Champaign	M.A. and M.S. in Economics	88
Western Illinois University	M.A. in Economics	27
	GRAND TOTAL:	**244**

Institution	Program Name	Total
Illinois State University	M.A. and M.S. in Sociology	30
Northern Illinois University	M.A. in Sociology	31
Southern Illinois University Carbondale	M.A. in Sociology	10
Southern Illinois University Edwardsville	M.A. in Sociology	18
U of I at Chicago	M.A. in Sociology	16
U of I at Urbana/Champaign	M.A. in Sociology	4
Western Illinois University	M.A. in Sociology	25
	GRAND TOTAL:	**134**