# Student Flow Analysis for a Community College

**Terrence Willett**
California Partnership for Achieving Student Success

**Willard Hom**
System Office of the California Community Colleges.

*The authors describe an innovative technique for using Classification and Regression Tree (CART) with student characteristics, including geographical data for analyzing student enrollment patterns between students who enroll within a community college district (stayers) and those who enroll outside the district (movers) at neighboring community colleges. This article describes a method for conducting a student flow analysis and demonstrates the method with an actual analysis at Gavilan College in Gilroy, California. This is a useful tool for research and planning professionals involved in enrollment management and marketing for community colleges at the program or discipline level.*

## Introduction

Community colleges actively pursue enrollment planning in order to succeed in a changing environment (Seidman, 1995; Hossler, 1986). This is especially important in California in an age when enrollment level drives a community college's funding. As a result of this fiscal link to enrollment, a community college may discover a critical need to compete with other providers of postsecondary education to draw sufficient numbers of students to its campus. If a community college cannot draw enough students, it may begin to lose its ability to maintain its breadth of educational services and staffing. In California's K-12 segment, the effects of declining enrollment in some places have even manifested in plans to close educational facilities, creating many concerns (Lapkoff & Gobalet, 2004).

As an important part of enrollment planning and the institution's strategic planning, community colleges, like other postsecondary institutions, must learn about the market they serve (Becker, 1990; Keller, 1983; Mudie, 1978; Turner, 1978; Larkin, 1979). This learning essentially involves the practice of market research, although higher education usually classifies the market research function as "institutional research." The concept of marketing has historically troubled experts in higher education (Litten, 1980). Regardless of the title used, a community college can move forward in its market research if it can analyze the geographical dimension of its market. The geographical dimension of a market has been a basic consideration in market analysis in the private sector (Kotler, 2003; Lehmann & Winer, 2002; Peter & Donnelly, 2000; Mintzberg & Quinn, 1992) and community colleges can leverage this model to their advantage. Some community colleges have also tried this path (Northern Virginia Community College, 2002). Given the localized nature of their enrollments, in comparison to most four-year institutions, the geographic dimension clearly carries more weight in the community college environment than in the four-year sector (Rowley & Sherman, 2001).

Like many business enterprises, a community college typically has a market area—a region that it serves. In California, community colleges have designated physical boundaries referred to as the community college district. But California's Master Plan diminished the meaning of district boundaries when its provision for open enrollment became law. In effect, community colleges in California could legally enroll students who reside in another community college district. In other words, a college may import students (i.e., students flow in from another district), and it may export students (i.e., students flow out to another district). The concept of student flow analysis, as covered in this article, focuses upon the nature of exports for a community college. That is, does a community college district "lose" some of "its" residents by "sending" them to another community college?

In this article, it is assumed that a community college would prefer to import students rather than export them, given the usual gains in funding that accrue with higher enrollments. However, if a community college lacked the capacity to serve the number of students who wished to enroll there, it is conceivable that this institution would prefer to export some of these students. This would be especially true of students in high-cost programs such as health service or industrial technologies that require a low student-teacher ratio and/or specialized equipment and facilities.

The concept of importing and exporting students has one additional facet worth noting here. Students may, and frequently do, enroll concurrently at more than one community college during any given semester. This phenomenon of concurrent enrollment at multiple community colleges can compound the outflow of students who choose to attend only one community college. Moreover, it can signal to an administrator that his/her community college has emerging gaps in its services or curriculum. This phenomenon of student enrollments at multiple community colleges has become widespread, and researchers have labeled it as "double-dipping" and "swirl" (Borden, 2004; Adelman, 2005).

To understand its geographic market, a community college must analyze the pattern of student exports (outflow to other community colleges) and imports (inflow from other community colleges). The concept of student flow analysis links to recent developments in geographic information systems (GIS), which has expanded the kinds of questions that researchers can answer (Granados, 2003; Mora, 2003). At the same time, student flow analysis with GIS can also help to address a traditional benchmark of higher education, the student participation rate (Gaither, 1979).

It may help to frame the enrollment choice of district residents as a "brand-switching" situation in market research (Lehmann & Winer, 2002). In this framework, residents of the Gavilan Joint Community College District (GJCCD) who choose to enroll at Gavilan College would receive the label of "stayers" while residents of the GJCCD who choose to enroll at a different community college would receive the label of "movers." The terms "mover" and "stayer" give us logically meaningful and conveniently brief names for the two types of community college enrollees that this study analyzes. Not addressed in this report are students enrolled in distance education classes. At the time of this study, distance education was a small but growing component of the curriculum and should be included in future research.

Student flow analysis is most feasible if an inter-district dataset of student enrollments is available to the analyst. In California, the System Office of the California Community Colleges (hereafter referred to as the "System Office") maintains such a dataset, and the System Office cooperates with the districts to facilitate such analyses. This article describes a method for conducting a student flow analysis and it demonstrates the method with an actual analysis that Gavilan College completed with the assistance of the System Office.

## Background

The Gavilan College District is in central California about 30 miles east of the Pacific Ocean, and it encompasses about 2,700 square miles (southern Santa Clara County and much of San Benito County). The district has one college, Gavilan College, which has its main campus in the town of Gilroy about 35 miles south east of San Jose. Gavilan has expanded its access for students with the operation of additional learning facilities in the towns of Hollister and Morgan Hill. The college began in 1919, but the present campus in Gilroy sprang from a successful

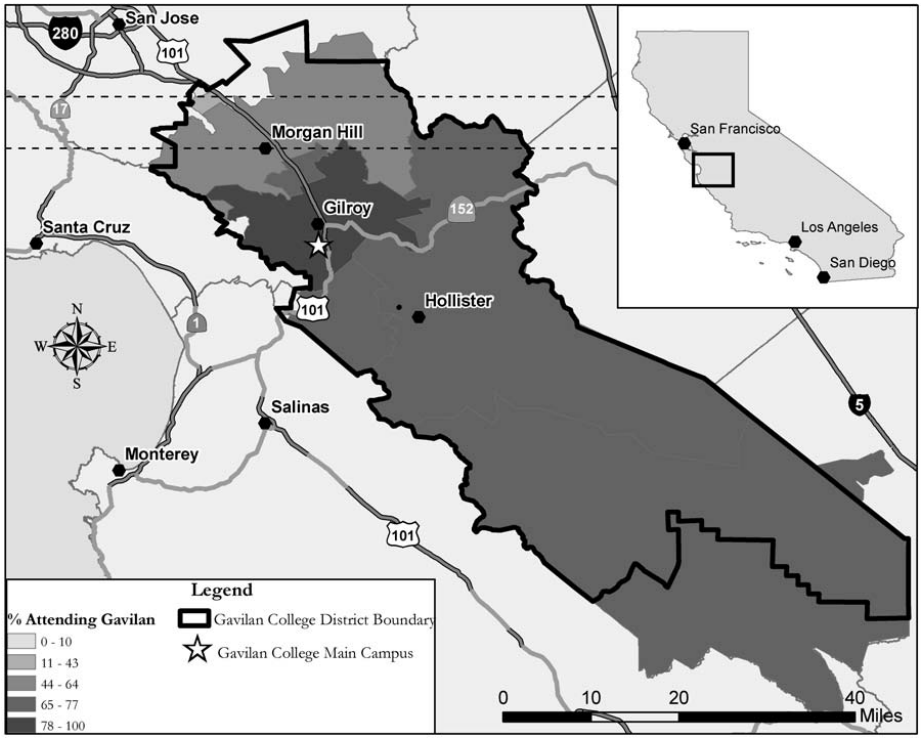
bond measure in 1966. For the 2003 Fall term, Gavilan enrolled 4,700 students. The racial/ethnic distribution of these students was about 47 percent Latino, 40 percent White (non-Hispanic), and 2 percent African-American.

## Data

The System Office manages a data warehouse that contains student level data on all students in the California Community Colleges since at least 1994 for most colleges. These data include student demographics, zip code of student residence, course enrollments and grades, course characteristics, degrees and certificates awarded, and other related variables. To conduct this study, a subset of these key variables was extracted for students who had enrolled in a California community college in the Fall 2001, Fall 2002, or Fall 2003 terms, and who reported a residence zip code that fell within the Gavilan district boundary, regardless of college of attendance. This extract contained 58,815 enrollments for 19,907 unique individuals at 75 of the 109 community colleges that existed in the state at that time. Eight colleges enrolled 95 percent of these students with just over two-thirds of them enrolled at Gavilan College. These data had passed through a validation process when uploaded from a local college to the System Office and they were screened again for errors prior to the analysis. Some inconsistencies in course coding were found and were addressed during the analysis.

## Methods and Results

To avoid confusion, it is necessary to note that all of the student counts used in this study are unduplicated headcounts or enrollments as indicated, rather than counts of full-time equivalent students (commonly referred to as FTES). The initial analysis of student flow discovered that roughly one-third of the individual community college students who live within the Gavilan district attended another commu-




**Note:** Dashed lines indicate the CART analysis split where student enrollment between the lines was conditional on the types of courses taken.

**Figure 1. Percent of Students Attending Gavilan College by Location**

nity college. Thus one-third of these students were movers while two-thirds were stayers. The proportion of movers appears stable over the three year study period. Stayers tend to attempt a mean of 7.3 units with a standard deviation of 5.0 while movers attempt a mean of 6.6 units with a standard deviation of 5.3 units. This suggests that a slightly larger fraction of the movers are part-time students or students with smaller unit loads in comparison to stayers.

In general, it appears that movers live closer to San Jose than do stayers. The map (Figure 1) illustrates the effect of student place of residence on community college attendance.

Gavilan's sphere of influence appears strongest in Gilroy, but it diminishes gradually to the south and rapidly to the north. Statistical analyses suggest that compared to stayers, movers are 1.2 times more likely to be male (Chi-square (1) = 367.99, $p < 0.0005$), 2.2 times more likely to be non-Hispanic (Chi-square (5) = 620.03, $p < 0.0005$), about one and a half years younger (Mann-Whitney U test, $Z = -3.216$, $p = 0.001$), and attempt fewer units in a term (6.6 compared to 7.3, Mann-Whitney U test, $Z = -9.892$, $p < 0.0005$). Finally, stayers are 3 times more likely to either have no high school diploma or have a Bachelor's degree or above (Chi-square (3) = 124.426, $p < 0.0005$).

## Course Taking Patterns and Student Flow

Eighty-three percent of the movers chose to enroll at one of seven neighboring community colleges (Cabrillo, De Anza, Evergreen Valley, Foothill, Hartnell, Monterey Peninsula, and San Jose City). By focusing on enrollments at Gavilan and these seven neighboring community colleges, we see that about 75 percent of enrollments by residents occur at Gavilan (i.e., are stayers) and that 25 percent occur at other neighboring colleges (i.e., are movers). Some programs show more movers than the average of 25 percent. This suggests these are programs that Gavilan could potentially expand to attract students given its constraints on resources and other factors. In other words, Gavilan's administration could consider any class or program where more than 25 percent of the enrollments are at other colleges as signals of unmet demand. Conversely, if a class or program has more than 75 percent of its enrollments occurring at Gavilan, an administrator could categorize that class or program as one with strong appeal for local residents.

The analysis can exploit the fact that courses are classified according to a coding scheme called the Taxonomy of Programs (or commonly abbreviated to "TOP code"). This is a six-digit code where the first two digits indicate very broad subject areas and the remaining digits indicate more specific classes within this broad area. For example, "150000" is the generic code for humanities classes, "150100" is the code for English classes such as college composition, and "150900" is the code for philosophy classes.

Table 1 presents enrollments in selected disciplines at the highest level of the TOP hierarchy, and this table is sorted in descending percents and counts of movers (non-Gavilan enrollments). At the top of the table are programs that are not offered at Gavilan (i.e. Agriculture and Natural Resources). Just below these programs is a group of offerings at Gavilan for which proportionately more students are movers, suggesting that there may be an unmet need in these areas. In this category are Public and Protective Services, Engineering (not shown), and Health (not shown). Within these broad categories it appears that specific programs with heavy enrollments at other colleges (i.e., many movers) include Administration of Justice, Health Education, Nursing (RN), and Police and Fire training. Other areas that could be included in the category of unmet demand, based on the number of enrollments at other colleges, are Engineering and Industrial Technologies (not shown). However those programs are unlikely to be resumed at Gavilan due to historic difficulties in maintaining enrollments in these programs.

The next grouping of programs could be considered "bread and butter" programs that appear to draw local residents and constitute the bulk of Gavilan's enrollments. These programs include Interdisciplinary Studies, which mostly comprises basic skills and pre-transfer level Math, basic skills English and ESL, as well as supervised tutoring and Humanities. Mathematics also appears to have many movers. However, Gavilan's basic skills math and elementary and intermediate algebra classes are coded under Interdisciplinary Studies while other colleges often code these classes under Mathematics. All math classes, regardless of TOP code, are shown at the bottom of Table 1.

## Multivariate Analysis of Attendance Behavior

The next step of this analysis was to examine demographics and course-taking behavior simultaneously in a multivariate analysis. The classification and regression tree (CART) approach was used for the analysis. CART has been a common approach for finding patterns in complex data (Breiman, Friedman, Olshen & Stone, 1994). CART analysis does this by creating a set of dichotomous rules that best predict the dependent variable. It is a more robust technique than stepwise regression because there are no distributional assumptions. Both categorical and interval variables can be used as either the independent or dependent variable, and missing data can be treated as another category so that all available data are used in the model. In addition, CART can model non-linear trends and interactions between variables without explicitly specifying them beforehand. These features tend to make it a very useful technique in exploratory modeling.

The CART analysis used a set of variables to predict whether a given student enrollment would be at Gavilan or a neighboring college (i.e. predicting mover versus stayer behavior). Several categories of predictors were used. The first category was a time element to detect temporal trends, although, with only three years of data this was not expected to be a strong predictor. Next were a set of variables related to the students' characteristics including demographics and experience as a student. Another set of variables were course characteristic variables to see if course hours, courses in particular disciplines, or courses at certain skill levels were chosen to be taken at other colleges as opposed to Gavilan. Student success in each enrollment was added to see the influence of student achievement on college choice. Finally, the latitude of a student's residence zip code was included as a predictor to explore the possible influence of geography on student choice. Longitude was not used due to the strong north-south orientation of the district and major roads.

The CART analysis used 53,753 enrollments by 13,444 individuals at either Gavilan or an adjacent district and was conducted with Clementine® 10.1. Note that enrollment in this context describes a seat in one course section at the college. Because the CART model is strengthened when outcomes are equally distributed or balanced, cases were randomly omitted from the stayer category, resulting in 28,169 enrollments for the CART analysis with an even distribution of stayers and movers. Approximately half of the 28,169 enrollments were randomly selected for use as a training sample to build the predictive model, then CART used the remaining half as the test sample. The resultant model correctly classified 72 percent of the students, which is above the 50 percent rate expected from random guessing of the enrollment category (see Table 3). The model was slightly more likely to correctly classify a stayer and to misclassify a mover as a stayer.

TOP code and proximity to San Jose appeared to be the most important variables in predicting enrollment decisions as these variables created the first splits in the tree (Table 4). In general, it appeared

**Table 1. Count and Percent of Enrollment for Stayers and Movers by Selected TOP Codes**

| | Enrollment Count | | Enrollment Percent | |
|---|---|---|---|---|
| **Program Name** | **Stayers** | **Movers** | **Stayers** | **Movers** |
| Agriculture and Natural Resources | 0 | 399 | 0% | 100% |
| Public and Protective Services | 1842 | 9599 | 16% | 84% |
| Mathematics | 2834 | 1934 | 59% | 41% |
| Information Technology | 2733 | 810 | 77% | 23% |
| Psychology | 2880 | 722 | 80% | 20% |
| Fine and Applied Arts | 9015 | 1950 | 82% | 18% |
| Business and Management | 9347 | 1642 | 85% | 15% |
| Interdisciplinary Studies | 29025 | 3380 | 90% | 10% |
| Environmental Sciences and Technologies (new) | 0 | 0 | 0% | 0% |
| All Courses | 109964 | 37355 | 75% | 25% |
| All Math Courses | 10236 | 2027 | 83% | 17% |

that those taking specialty vocational courses were more likely to attend another college. Those taking general education/transfer preparation courses had a strong geographic split in enrollment behavior. Those who lived north of Morgan Hill (latitude greater than 37.19º, Figure 1) were more likely to "move" while those who lived south of Morgan Hill (latitude less than 37.13º) were in general more likely to "stay".

## Qualitative Follow-Up Research

In response to these enrollment findings, a task force was formed to create a set of strategies to enhance the college's service to the local community. The approach used in the analysis of course-taking patterns for movers and stayers depends upon a major assumption. This approach assumes that movers who take courses that are readily available at Gavilan have manifested a preference for another community college's course offering. On the flip side, an analyst would tend to assume that non-Gavilan residents who take courses at Gavilan have demonstrated a preference for Gavilan's offering in comparison to other relatively accessible community colleges offering the same course. However, in light of past research, the concept of student choice encompasses many more factors than just student evaluation of course quality; a wide array of factors affects each student's actual enrollment behaviors (Broekemier, 2002; Cabrera & La Nasa, 2000; Hossler, Schmit & Vesper, 1999; Wiese, 1994; Paulsen, 1990; Bers & Smith, 1987; Chapman, 1986; Laroche, Rosenblatt & Sinclair, 1984; Manski & Wise, 1983; Spekman, Harvey & Bloom, 1980). For example, researchers have identified factors such as curriculum, cost, enrollment (size and composition), campus image, and accessibility (that is, both location and selectivity) among other things, as influences of individual enrollment behavior. Therefore, these factors, not just the quality of a particular class or

**Table 2. Predictor Variables Used for Student Attendance Decision**

| Predictor | Function of Predictor |
|---|---|
| Time (3 successive Fall terms) | Temporal trends |
| Age | Demographic influence |
| Cumulative Units Attempted (student experience) | Demographic influence |
| Educational Level | Demographic influence |
| Ethnicity | Demographic influence |
| Gender | Demographic influence |
| Meeting Days | Effect of course scheduling |
| Term length (short vs. full term) | Effect of course scheduling |
| Course Units | Effect of student course load |
| Latitude | Geographic influence |
| Success | Student achievement |
| Basic Skills Status | Student demand for certain courses |
| Degree Applicability | Student demand for certain courses |
| TOP code | Student demand for certain courses |
| Transferability | Student demand for certain courses |

**Table 3. Analysis of CART Model Predictions**

| | Predicted Category | | |
|---|---|---|---|
| **Actual Category** | **Mover** | **Stayer** | **Count** |
| Mover | 4,755 (34%) | 2,316 (16%) | 7,071 |
| Stayer | 1,752 (12%) | 5,342 (38%) | 7,094 |
| Count | 6,507 | 7,658 | 14,165 |

program, could receive credit for motivating a district resident to become a mover. Because of the strong possible influence of these factors, the task force felt it needed more information on the influence of students' perceptions and attitudes on moving and staying decisions.

With assistance from the Gavilan Research Office, task force members conducted a series of focus groups and a survey of recent high school graduates from one of the three main feeder high schools in the area. The main findings suggested that recent high school graduates who chose to attend Gavilan (one group of stayers) may place higher value on reducing the cost of attendance by living with parents to lower housing and commuting expenses. Furthermore, students just out of high school who become movers may place higher value on having new experiences in a new area, "getting away" from high school classmates, or going to a college with a high reputation. In particular, some neighboring districts have very high reputations in the community as suggested by an earlier phone survey of residents in which they were asked to rank local community colleges. One aspect of reputation that emerged was the quality of facilities at Gavilan versus colleges with newer, more modern facilities. Students who had attended elsewhere as well as Gavilan suggested that they felt they received more personal attention at Gavilan and

**Table 4. Decision Tree for Predicting Mover/Stayer Status from CART Analysis**

(1) If course type is Agriculture and Natural Resources, Architecture and Environmental Design, Engineering and Industrial Technologies, Foreign Language, Health, Law, Library Science, Mathematics, Military Studies, or Public and Protective Services, then prediction is **Mover** (2,964; 0.79)

(1') If course type is Biological Sciences, Business and Management, Commercial Services, Education, Family and Consumer Sciences, Fine and Applied Arts, Humanities, Information Technology, Interdisciplinary Studies, Media and Communications, Physical Sciences, Psychology, or Social Sciences

- (2) and if latitude <= 37.13º
  - (3) and if course type is Commercial Services or Interdisciplinary Studies, then prediction is **Stayer** (2,108; 0.855)
  - (3') and if course type is Biological Sciences, Business and Management, Education, Family and Consumer Sciences, Fine and Applied Arts, Humanities, Information Technology, Media and Communications, Physical Sciences, Psychology, or Social Sciences
    - (4) and if course is degree applicable
      - (5) and if ethnicity is Asian/Pacific Islander or Other/Unknown, then predicted category is **Mover** (666; 0.523)
      - (5') and if ethnicity is African-American, Latino, Native American, or White, non-Hispanic, then predicted category is **Stayer** (4,419; 0.649)
    - (4') and if course is not degree applicable
      - (6) if course type is Education, then predicted category is **Stayer** (75; 0.893)
      - (6') and if course type is Biological Sciences, Business and Management, Family and Consumer Sciences, Fine and Applied Arts, Humanities, or Information Technology, then predicted category is **Mover** (160; 0.994)
- (2') and if latitude > 37.13º
  - (7) and if latitude <= 37.19º
    - (8) and if cumulative units attempted <= 12.25
      - (9) and if ethnicity is African-American, Asian/Pacific Islander, Native American, or Other/Unknown, then predicted category is **Mover** (208; 0.615)
      - (9') and if ethnicity is Latino or White, non-Hispanic, then predicted category is **Stayer** (791; 0.656)
    - (8') and if cumulative units attempted > 12.25
      - (10) if age <= 31.5 years, then predicted category is **Mover** (1,727; 0.658)
      - (10') and if age > 31.5 years, then predicted category is **Stayer** (237; 0.557)
  - (7') and if latitude > 37.19º, then predicted category is **Mover** (673; 0.967)

*Note:* Numbers in parentheses show *n*'s and confidence indices respectively. Confidence indices can take any value from 0 through 1, where the higher number indicates greater confidence.

that the quality of instruction and services was equivalent to other schools.

These possible factors, along with the enrollment patterns, led to several strategies. These included the continued improvement of facilities—an effort that had recently begun through a successful bond measure; improved marketing to highlight the comparative strengths of Gavilan; and more course offerings desired by the local community.

## Discussion

The evaluation of the Gavilan data on movers and stayers could add a dimension if analysts could compare these numbers to those for other colleges/districts in California. At this point, the analyst can use the present data to note any gross trend over time, but a comparison of Gavilan's results to those from other districts could help administrators understand whether these results are normal or extreme, in a sense.

This article focused upon exported students because student enrollment outside of the district was the real advancement in research for Gavilan. Before this study, Gavilan lacked the data on out-of-district enrollments with which to analyze its exports (i.e., its outflow). However, every district that captures in its database the residence zip codes of its students can conduct an analysis of its imported students. Since the analysis of imported students is fairly common, this article omitted coverage of this valuable component of student flow analysis. Nonetheless, it is important for a college to analyze its imports in concert with an analysis of its exports (the mover/stayer concept) in order to obtain a comprehensive understanding of its student flow to facilitate strategic planning and institutional marketing. The analysis of imported students would use much the same tools as those used in the analysis of exported students (i.e., GIS and CART) so there is no additional technical difficulty in analyzing imported students. The product of the import analysis could indicate campus qualities that have strong drawing power in a region (including superior curriculum, faculty, and facility), and it could find a displacement effect (where out-of-district students may crowd out district students in a college already at maximum capacity) that may concern a governing board or community members.

The Gavilan study also restricts its scope to the movement of its residents to other community colleges. This restricted scope reflects a major assumption that may not apply to other community colleges. That assumption is the need to focus upon the diversion of potential Gavilan students to other community colleges in the area. For Gavilan, this restriction is appropriate, given that it only wanted to focus upon its residents who selected a fairly comparable substitute for Gavilan College. However, other community college administrators may want to understand how their institutions may be losing students to institutions such as private postsecondary schools. Put another way, other district administrators may need to evaluate their enrollment demands with respect to locally accessible education and training providers that may not appear to be direct substitutes for a community college (i.e., a neighboring community college/district). This could include the extension courses that four-year institutions offer or focused worker training that proprietary/trade schools provide.

A major enhancement for planning by the Gavilan District would be a comprehensive survey of the movers so that administrators could learn about the factors that motivated a district resident to enroll elsewhere. The integration of a GIS analysis with survey research produces a powerful combination for the analysis of enrollments (Blough, 2003). With a survey of movers, the researcher could pinpoint those motivating factors that the administration could possibly remedy as well as those factors that fall clearly beyond the influence of the administration (Vaughn, Pitlik & Hansotia, 1978). Future research could test the applicability of so-called "gravity and spatial interaction models" to community colleges (Hope & Muhlemann, 1997; Cadwallader, 1996; Walmsley & Lewis, 1993). These models, which stem from *Reilly's law of retail gravitation*, have aided facility and market planners in the private sector, and these tools have had some application in the analysis of enrollments in higher education as well (Haynes & Fotheringham, 1984). Even if these models may not explain why specific types of students become movers, they can help college officials to plan facility location and facility size and to estimate the effect of alternative providers of postsecondary education (i.e., competitors in the higher education market).

## Conclusion

For Gavilan, this student flow analysis led to some administrative actions. The district re-evaluated its offerings at its Morgan Hill site. The administration incorporated the analysis into its marketing plan and its enrollment management plan. The analysis will eventually contribute to the district's strategic plan as well. Gavilan's Board of Trustees welcomed the student flow analysis because it gave the trustees a research-based action plan. However, Gavilan's benefits were only part of the impact of this new analysis.

With the help of the System Office, a number of other districts in Gavilan's area also undertook student flow analyses, and their institutional research offices produced reports for their administrations as well. In fact, within twelve months of the release of Gavilan's student flow analysis, at least ten districts had undertaken similar efforts, and some of these districts were in southern California.

Student flow analysis may see a new role in the coming years. The concept of a fixed geographic service area may lose some of its meaning if distance education programs can increasingly attract widely dispersed clienteles that live hundreds of miles away or several counties away. A student flow analysis can identify students that a district may be losing to another community college that has a strong distance education program. Not only would the analysis enable a district to detect reduced enrollments (or "missing students"), the analysis of why students choose a different education provider may indicate possible weaknesses in a district's core traditional program or curriculum. But it is worth noting that technological change (such as the Internet) has affected the spatial dimension of research by sometimes reducing the importance of physical location and space (Shen, 2004).

On the other hand, certain rural colleges may come to need a student flow analysis as urban development (or sprawl) in adjacent college territories leads to the development of satellite learning facilities that the neighboring district believes is necessary to serve its expanding (or disbursing) population. However, an unintended consequence of these satellite classrooms for a neighboring district may be the attraction of students away from the rural college.

Student flow analyses may eventually serve to support enrollment forecasts that factor into capital outlay plans. This is especially relevant for a district that provides postsecondary education to people who reside outside of its district boundaries but who believe they are too distant from their own district's learning facilities. Presently, the enrollment forecasts of the System Office only consider the population growth (and high school graduation rates) of areas within each district. It may eventually become feasible for a district to support capital outlay plans with enrollment projections that include a time series for student flows of residents from beyond district boundaries (i.e., imports).

Finally, the aspect of energy resources and urban development may magnify the need to conduct student flow analysis. If fuel prices climb dramatically, then students who currently must drive long distances to reach a campus may become dropouts due to limited budgets (or alternatively, they may become applicants for financial aid or patrons of mass transit). A student flow analysis could project the number and location of students who might face this predicament under a scenario of exorbitant fuel prices. Secondly, if urban development dramatically changes the commute time to a community college, then a student flow analysis could identify the number and location of students who may be affected by the change in their access to the campus. This may lead to the expansion of satellite learning centers and off-site classrooms, an expansion of distance education programs, or even the mitigation of traffic bottlenecks by municipalities.

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**Terrence Willett** *is the former Director of Research at Gavilan Community College and is currently the Director of Research for the California Partnership for Achieving Student Success. He can be contacted at:* twillett@calpass.org

**Willard Hom** *is the Director of Research & Planning for the System Office of the California Community Colleges. His e-mail is:* whom@cccco.edu.