# PREDICTING PARKING DEMAND FOR UNIVERSITIES

BY JOHN W. DORSETT

Do you have a parking shortage? Have you ever wondered why? Many master planners fall into the trap of using a simple equation to predict future parking demand for learning institutions. A ratio of so many students per parking space or so many staff members per parking space is sometimes used. The result is often that sufficient parking is not provided or that far too much parking is provided. When insufficient parking is provided, constituent groups often complain and beg for more parking. Conversely, when parking is overabundant, financial resources are being wasted.

Common sense would lead one to believe that a direct relationship exists between campus population and parking demand. One would reason that the more students, faculty, and staff members on campus, the higher the parking demand. Since this is true, would it not be simple to predict parking demand based on some formula using campus population as an independent variable? Not so, says this author. Some link does exist; however, many other variables affect parking demand, discounting the belief of a simple cause and effect relationship.

This article demonstrates that no one formula can be used to accurately predict the parking demand of a university campus. Not even one of the statistician's favorite tools, the regression line, can accurately predict parking demand for a university campus. (A regression analysis is a statistical technique used to develop an equation that relates an independent variable to a dependent or predictor variable. It is possible to determine the strength of the relationship between two variables through a regression analysis.) Since a direct link between campus population and parking demand cannot be made, alternatives to predicting parking demand are presented.

The author collected data describing the population and parking characteristics of 22 universities and colleges located throughout the United States. A regression analysis was performed to determine how strong the relationship is between campus population and parking demand.

## THE STUDY

The colleges and universities included in this study represent a cross-section of campuses located throughout the nation. Small, medium, and large-sized campuses, located in both urban and suburban settings comprise those campuses studied. Campuses that have both relatively large and small percentages of commuters are represented by the sample. The smallest institution represented in this study has about 4,000 students, while the largest institution has an enrollment of over 35,000 students. For the institutions represented in this study, resident students comprise between zero percent and 52 percent of total enrollment. Table 1 provides a profile of the size of the learning institutions included in this study.

**TABLE 1**

SIZE OF INSTITUTION

| Student Enrollment | Number | Percent |
|---|---|---|
| Less than 10,000 | 4 | 18% |
| 10,001 - 20,000 | 7 | 32% |
| 20,001 - 30,000 | 8 | 36% |
| More than 30,000 | 3 | 14% |
| TOTAL | 22 | 100% |

Four of the 22 institutions studied have less than 10,000 students, representing 18 percent of the total group. Colleges and universities having between 10,001 and 30,000 students comprise over two-thirds of the sample. There were three institutions that have over 30,000 students; this represents 14 percent of the study group.

The colleges and universities studied represent a diverse number of geographic locations. Nine of the institutions studied are situated in midwestern states, eight are located in western states, and five are located in eastern states. The data representing the institutions included in this study were collected during 1986–1992. Included is student enrollment, the number of resident students, employment, the number of parking spaces, and the number of parking spaces occupied during the peak hour on a day representing typical parking conditions. The number of parking spaces occupied during the peak hour often

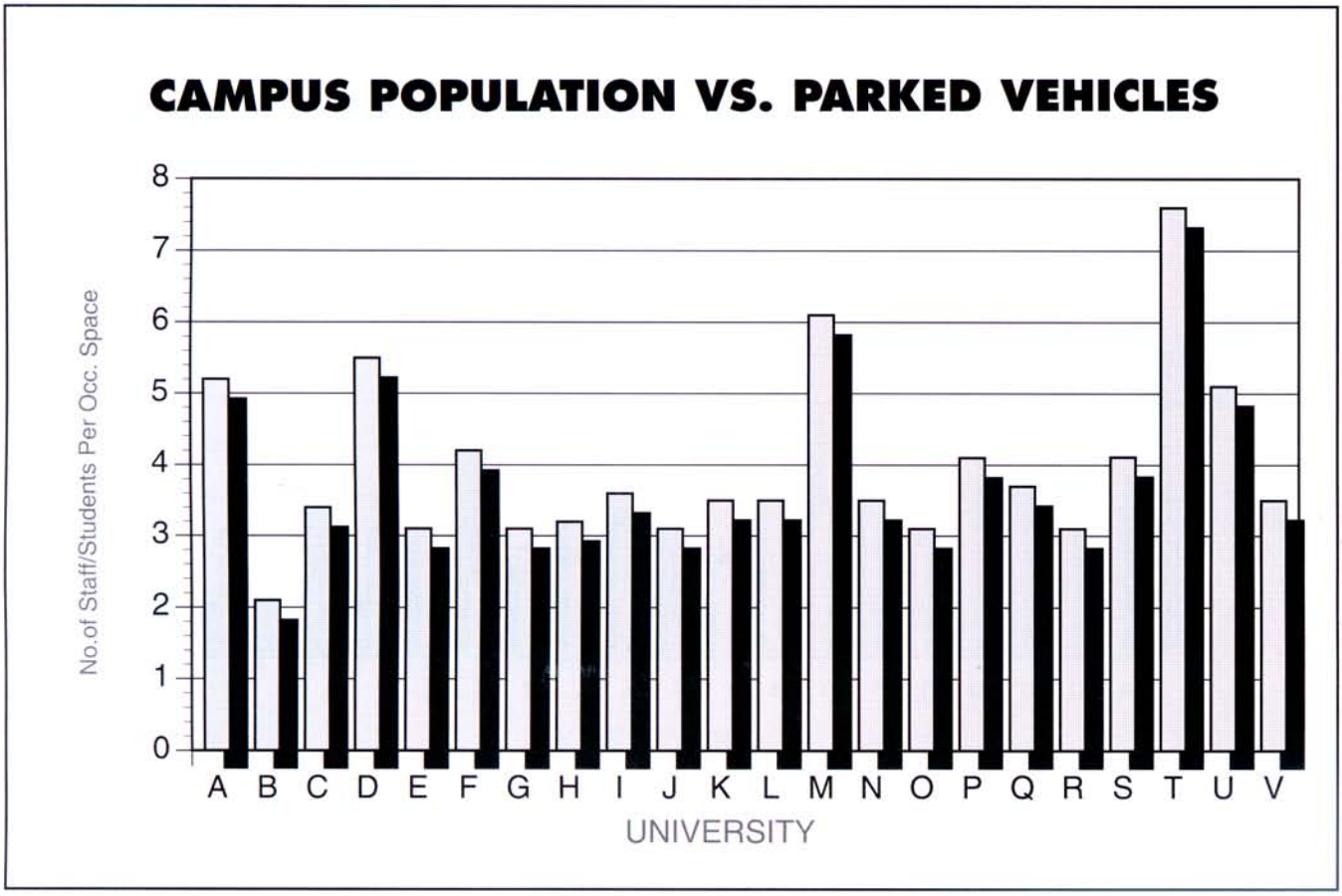


**FIGURE 2**

population and parking demand. The author believes that this is due to the wide range of dynamics characterizing learning institutions. Each learning institution is unique. The following are variables impacting parking demand at colleges and universities. These make it difficult to predict parking demand using a simple mathematical equation.

■ ***City and Campus Transit Systems*** —The strength of both the city and campus transit system has a direct impact on the percentage of employees and students who drive vehicles to a campus. Strong bus systems both on- and off-campus contribute toward reducing parking demand. Some of the institutions studied have on-campus bus lines, while others do not.

■ ***Student/Staff Ratio***—The student/staff ratio varies considerably among the institutions studied. The low end of the range was represented by 1.6 students for every staff member, while the high end of the range was represented by 10.7 students for every staff member. The percentage of staff who drive a vehicle to the campus is usually higher than the percentage of students who drive a vehicle to campus. Therefore, institutions that have relatively high student/staff ratios tend to have a low per capita parking demand than those having relatively lower student/staff ratios.

■ ***Parking Policies***—Some learning institutions restrict the development of parking because of various reasons including environmental concerns, traffic and safety concerns, and lack of financial resources. This policy, regardless of the reason, can restrict parking demand because if people cannot find a parking space, they are forced to use alternative modes of transportation. Under these circumstances, many students will choose not to keep a vehicle on campus. Several of the institutions included in this study have maintained this policy. Other institutions have discouraged the use of a vehicle on campus by charging relatively high parking fees.

■ ***Schedules***—While class schedules may have a dramatic impact on enrollment and campus population, they may not significantly impact peak hour parking demand. For example, universities and colleges that do not have very many afternoon and evening classes will probably have relatively lower enrollments than those that do choose to schedule many afternoon or evening classes. A relatively high number of afternoon and evening classes may result in a significant increase in student enrollment. However, peak hour parking demand may not vary.

■ ***Municipal Influences***—Some campuses located in urban environments have restrictive parking regulations such as residential parking permit zones. This reduces parking spaces available to the institution.

## ALTERNATIVE SOLUTIONS TO PROJECTING PARKING DEMAND

Rather than project campus parking demand using a formula, a thorough understanding of the parking

represents not only parking demand conditions which most learning institutions design for, but also peak hour parking demand. (The peak hour represents the hour of an entire day when parking demand is at its highest.)

Two tests were performed. The first test included all 22 learning institutions. The second test included only those institutions where 20 percent or more of the student population are resident students. The second test was performed to determine whether or not commuter campuses were skewing the data by contributing an unusually high number of occupied parking spaces to the sample. It would be logical to think that commuter campuses have relatively higher levels of parking demand than resident campuses. However, the data analyzed in this study does not support this.

Using a computer program, a regression line was developed using the two variables, total campus population and the number of occupied parking spaces. Once the regression line was developed, the total population data were loaded into the regression line equation, resulting in a prediction of parking demand. The predicted parking demand was compared to the actual parking demand. The results of these plots are illustrated by the scatterplot contained in Figure 1. One set of data, the actual population and number of occupied parking spaces, is identified by squares. The second set of data represents the regression line; this line is identified by circles.

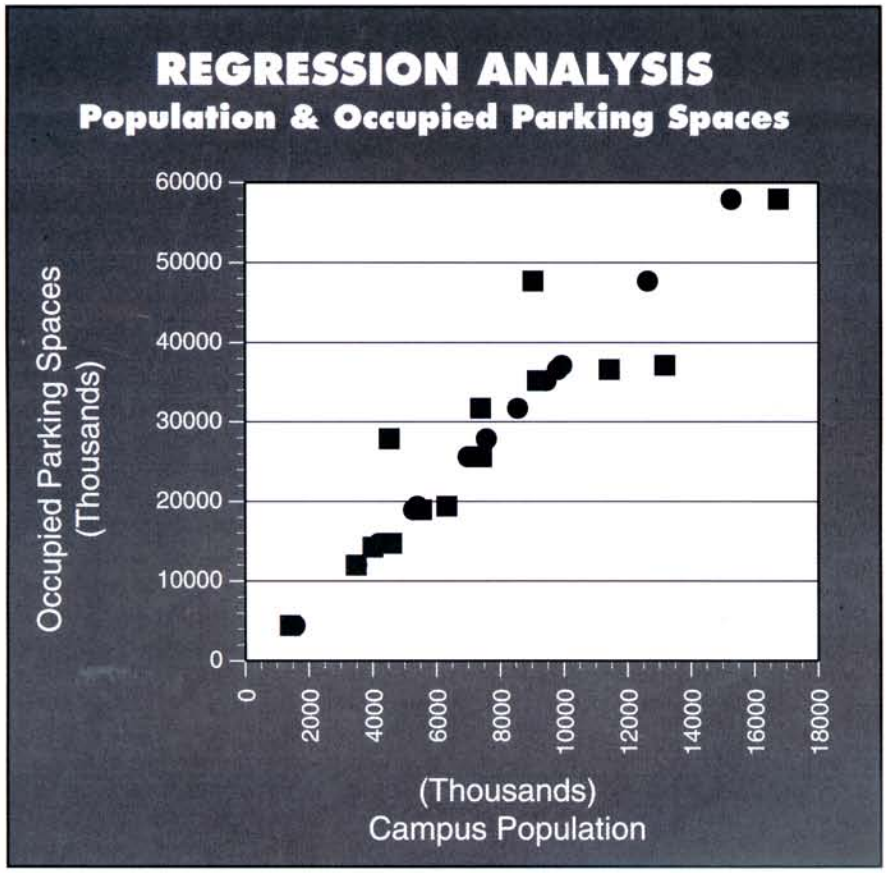


**FIGURE 1**

### TEST #1: ALL 22 INSTITUTIONS—

Under the first test, the statistician's regression line would have reliably predicted the actual number of occupied parking spaces (demand) only 13 out of 22 times, with a 20 percent margin of error. The remaining nine cases fell outside the 20 percent margin of error. With a ten percent margin of error, the equation was reliable only five out of 22 times. The mean variance between the actual parking occupancy and the predicted parking occupancy (demand) was 24.4 percent! This is an extremely high variance that virtually any planner would consider to be unacceptable.

### TEST #2: 20 PERCENT OR MORE RESIDENT STUDENTS—

The second test yielded even less reliable results. Only once out of 12 times did the regression line equation accurately predict actual parking occupancy within a ten percent margin or error. The mean variance between the actual parking occupancy and the predicted parking occupancy (demand) was 30.1 percent.

Figure 2 graphically depicts what a statistician would have predicted using the regression line compared to the actual parking occupancy. Each educational institution included in this study is represented by two bars on this chart. One bar represents the predicted number of occupied parking spaces. This stems directly from the regression line equation. The other bar represents the actual parking occupancy of the campus. This graph shows that many of the predictions were off 1,000 spaces or more.

Figure 3 provides another look at the data by illustrating the number of parking spaces occupied during the peak hour for every student, faculty, and staff member. Figure 3 demonstrates the wide variation associated with the data. The low end of the range is represented by 2.8 persons for each occupied parking space, whereas the high end of the range is represented by 7.6 persons for each occupied parking space. The group average is 3.9 persons per occupied parking space.

The graphs shown throughout this article demonstrate that a relationship does exist between campus population and the number of occupied parking spaces. However, the relationship is not strong enough to use as the sole criteria for projecting parking occupancy or demand. Other variables also determine parking occupancy and negate a 100 percent cause and effect relationship.

### OTHER VARIABLES THAT IMPACT PARKING DEMAND

Looking back at the results of this study, one might wonder why there is not a more direct link between total

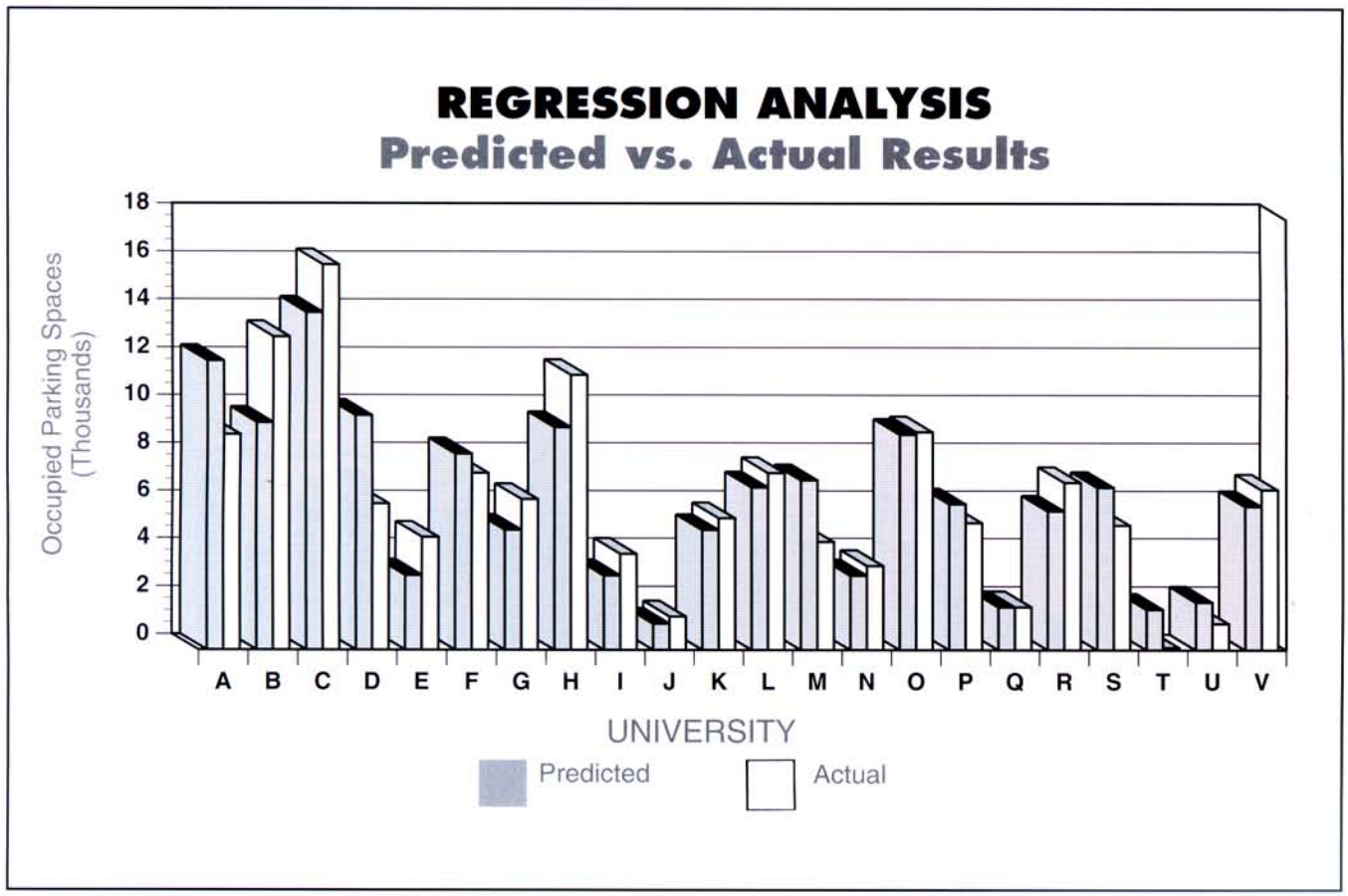


**FIGURE 3**

characteristics of a campuses' constituent user groups is needed. A study of each of these user groups—faculty, staff, student, and visitors—consists of identifying when these user groups are on campus and the percentage of each that drive or keep a vehicle on campus. It also helps to know where each of the user groups are actually parking and whether or not their parking needs are being met.

Planning for campus parking typically includes considerations other than ensuring that an adequate supply of parking exists. Some learning institutions want to know the following things:

- Where should the parking be located?
- Who needs more parking?
- What is the best way to effectively allocate parking resources between user groups?
- What alternative transportation modes are available that could be used to reduce the demand for parking spaces?
- How could these alternative transportation modes be marketed in order to restrict the growth of parking demand?
- Can the layout of existing parking facilities be improved in order to increase efficiency?
- What are the alternatives for adding parking facilities?
- Which of these alternatives is the most sensible?
- What parking rates should be charged to accomplish the financial objectives of the learning institution?
- How can the parking system be managed more effectively?
- How much will a new parking structure cost to build, operate and maintain?

Planning for a successful parking system requires a thorough understanding of user characteristics and the needs of the learning institution. It involves much more than using a simple formula to determine how much parking is needed. Planning is critical to ensure that the level of user frustration, the number of complaints, and an adequate supply of parking is provided. Planning is also critical to make sure that excessive money is not spent on parking. With structured parking costing $6,000 or more per space and surface parking running at $1,200 per space, who can afford to build more spaces than they really need? ■

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