

## **Institutional Research: Serving University Deans and Department Heads**

Matthew Foraker, Western Kentucky University

### **ABSTRACT**

Administrators at Western Kentucky University rely on the Office of Institutional Research to perform detailed statistical analyses to deepen the understanding of issues associated with enrollment management, student and faculty performance, and overall program operations. This paper presents several instances of analyses performed for the university to help it identify and recruit suitable candidates into its field, uncover root causes in grade and enrollment trends, evaluate faculty effectiveness, and assess the impact of student characteristics, programs or student activities on retention and graduation rates.

The paper briefly discusses the history of Institutional Research. It provides an overview of the data infrastructure created and utilized by the Office of Institutional Research at Western Kentucky University. It then presents five projects undertaken in support of university operations. One study examines the impact of students changing their majors on graduation rates. Another project analyzes grade trends in the same courses taught by different faculty and subsequent student behavior and success, providing insights into the nuances and subtleties of evaluating faculty performance. One investigation uncovers the possible influence of fraternities in freshmen general education courses. Two studies explore the impact of programs on student retention and graduation rates. Each example and its findings illustrate how Institutional Research can support the administration of university operations.

The target audience is any SAS professional interested in learning more about Institutional Research in higher education and how SAS software is used by an Institutional Research department to serve its organization.

### **INTRODUCTION**

When 100 third grade students were asked what they wanted to do when they grew up, positively none expressed interest in a career in institutional research. In fact, when asking university faculty about institutional research, fewer than half will know that it exists and even fewer know what it does. While a small number of graduate level certification programs have been developed, no undergraduate can declare a major in institutional research.

Higher education faculty and professionals typically discover institutional research when they enter administrative positions requiring them to obtain and analyze data regarding their operations. What have the enrollment trends been for a particular program? Do students with double majors take longer to graduate? How much longer? Of the students that start in an honors program, how many stay in the honors program until they graduate versus how many drop the honors program but remain at the university. How many starting in honors drop out of college completely? Do the students who participate in the new orientation program perform better than those who do not?

The ability to provide accurate and meaningful answers to questions like the above requires far more than data entry personnel and a grasp of statistics. Institutional Research professionals develop a rigorous

awareness of the organizations they serve by working daily with the facts and figures of the operation. As deans, department heads, faculty, or other administrators approach IR with requests for information, it is common that the request is clarified and modified before the answers are even sought, “Do you mean freshmen, or first-time freshmen, or first-time full-time freshmen, or first-time, full-time freshmen who live on campus?” This in-depth knowledge and understanding of the university has become an invaluable resource as the institution and its departments seek to improve their programs and operations.

## **A BRIEF HISTORY OF INSTITUTIONAL RESEARCH**

The earliest roots of Institutional Research date back to the early 1900s as higher education institutions sought to gain a deeper understanding of the issues facing their organizations. Universities started to organize investigations as “self-studies” or fact-finding missions to gather data and clarify situations impacting teaching effectiveness, efficiency, and productivity. The use of surveys to collect data began and grew during this early period.

The growth of Institutional Research escalated with the expansion of higher education fueled by the GI Bill after World War II. In the early 1960s educators created the National Institutional Research Forums (NIRF), scheduled to occur just prior to the annual meetings of the American Association for Higher Education (Reichard, 2012). In 1965, Congress passed the Higher Education Act of 1965, and in the same year, the NIRF evolved to become the Association for Institutional Research (AIR).

Title IV of The Higher Education Act of 1965 authorized an extensive federal financial aid program. The program required participating institutions to complete annual data collection surveys regarding institutional characteristics, pricing and financial aid statistics, enrollment counts and detailed demographics of students and faculty, and other information. This data produced the Integrated Postsecondary Education Data System (IPEDS). Combined with state reporting requirements, every college and university with students receiving federal aid had to dedicate resources to reporting. As higher education enrollments sky-rocketed after the legislation, other surveys for institutional data proliferated including Petersons Annual Survey of Undergraduate Institutions, The Princeton Review Survey, The College Board’s Annual Survey of Colleges, the ACT Graduate/Professional School Survey, and the NSF/NIH Survey of Graduate Students in Science and Engineering, and many others. The most well-known of these to the general public, the US News and World Report Best Colleges Survey, has been shown to influence student enrollment decisions.

The Institutional Research function grew within university administrations, often as a department within Academic Affairs, but also in some cases reporting to the President or other administrative departments such as institutional effectiveness or strategic planning (Volkwein, Ying, & Woodell, 2012). In addition to the regular reporting requirements, IR departments grew to serve the president and administration with a variety of research projects and other investigations to address institutional challenges and objectives. Additionally, many IR departments became available as resources to deans, department heads, and other managerial offices as a resource to gather and report information as required.

Higher education institutions vary widely in how they organize and label the institutional research function. Some have no such department labelled as such, but dedicate individuals inside of the information technology organization, or enrollment management, to provide the required statistics to the Department of Education and state agencies. Others have fully a developed and mature institutional research function with the awareness and expertise to not only conduct research at the request of university

leadership, but to spearhead its own research and provide universities valuable answers to important questions they didn't know to ask.

## THE WKU INSTITUTIONAL RESEARCH DATA WAREHOUSE

Western Kentucky University uses the BANNER Student Information System to manage the large amounts of data associated with applications, enrollment, course schedules, grades, and other aspects of its operations. The information technology department produces a data warehouse from this system to generate a large library of data sets. Each night this data warehouse, known as BANDW, is updated with current information as of that day. Examples of data sets within the BANDW data warehouse are listed in Table 1.

**TABLE 1: Examples of BANDW datasets**

DW_STUDENT_TERM	One row per student for each term enrolled that contains detailed information regarding credit hours earned, grades, and grade point average.
DW_GEN_PERSON	One row per individual (applicant, student, employee) entering the WKU system with contact information, gender, ethnicity, birth date, etc.
DW_STU_HI_TESTS	One row per student with the highest established test scores for the standardized tests (ACT, SAT, GRE, GMAT, etc.) and similar items (years of high school foreign language).

In addition to the BANDW data warehouse maintained by information technology, the Office of Institutional Research deploys SAS technology to produce its own data warehouse infrastructure consisting of a set of SAS libraries. Carefully written and well-maintained “generator” programs written in SAS produce highly designed and perfectly blocked (having the same number of identical variables with identical names, formats and labels) data sets inside libraries based on data type. The SASSETS library focuses on data associated with enrolled students. The APPS library contains data primarily focused on student applications, and the EMPLOYEES library contains data on WKU employees. For all of these, there is a separate data set for each term.

The SASSETS library contains blocked SAS data sets falling into three categories: 1) student/course records, one row of data for each student in each course, 2) course records, one row of data for each course, and 3) student records, one row of data for each student enrolled in the university. For each of these, a data set exists for each term (winter, spring, summer, and fall) of each year. The EMPLOYEES library contains one data set for each term that provides detailed data regarding the employees of the university including various human resources information and data required for submission to the annual IPEDS human resources survey.

The APPS library contains information obtained from student applications. This includes student contact information, high school and high school transcript data, test scores, desired major, and is updated to include student progress regarding completing the application, admission, and enrollment.

All of the data sets above have considerable redundancy with highly coordinated variables and variable names to allow for program flexibility when combining data sets of different types. Every individual in the system has two unique identifiers, a BANNER identification number, which is generally unknown and internal to the system, and a WKU “800” number that is well known and printed on student and employee

ID cards. These identifiers, as well as term codes, course codes, names have been constructed for ease of merging and combining tables.

In addition to well designed, consistent data sets, efficient analysis and research requires clean and accurate data. At WKU, the Office of Institutional Resources runs thorough and sophisticated “edit” programs that scan data for a large number of possible errors (for example, a student from particular state with a zip code from a different state). These programs substantially enhance the quality and completeness of the data within the system.

All of the employees in the department have strong base SAS programming skills. In addition to these, some have acquired proficiency with SAS Enterprise Miner for use of developing predictive models, while others have expertise in SAS Business Intelligence to produce an online Decision Support System (DSS) made available to identified leaders and managers within the university.

## **Study #1: Does Changing Majors Really Affect the Time to Graduate?**

At Western Kentucky University and many universities across the country, the perception existed that students are taking longer to graduate because they are changing majors. To investigate this at the WKU campus, Institutional Research conducted a study examining three years of first-time, full-time bachelor’s degree seeking students. The analysis tracked the progress of the students from term to term, noting any major changing activity producing a “sequence code” by adding a letter with each term indicating whether the student kept the same major, changed to a different major, or moved into or out of an undeclared major status.

### **The Sequence Code**

The first digit in the major change sequence code distinguished whether the student began with a declared major (first digit “D”) or an undeclared major (first digit “X”). From this term on, four possible major change behaviors were possible: 1) no change in major, coded as an “N”, 2) a change from one specified major to another specified major, coded as “C”, 3) a change from an undeclared status to a specified major, coded as “U”, and switching from one undeclared major to another undeclared major, also coded as an “N”. A change from one kind of undeclared status to another undeclared status was not considered a change. As students progressed, the sequence code grew a digit (with the code value for the major change behavior) with each completed term.

The number of possible sequence codes grew exponentially as students progressed, but the study found that only a small number of students changed their majors more than once. Of the 4,510 students in the study who completed two years, only 219 had changed their majors more than once. This refuted that notion that students were engaging in excessive changing of majors. Focusing on the other 4,291 students, the investigation found some intriguing results.

As shown in Table 2, the students with the strongest graduation rates were in fact those students who started with undeclared majors. Further, those students who waited one year, declaring their specific major during the fall of the sophomore year, were the strongest group in the study. Also, students who began with a declared major but changed it during their second term (spring) had stronger graduation rates than students who did not change their majors at all. The project concluded that students who defer the selection of a major until they have had some college experience, or that change a major quickly after gaining some experience, make more informed choices leading to stronger results.

However, students who remained undeclared past the first three terms experienced a considerable decline in graduation rates. The study reached two primary conclusions: 1) starting undeclared and declaring in the first three terms, or changing majors during the first three terms, is not problematic and in fact correlates with stronger graduation rates, and 2) remaining undeclared or changing majors after the sophomore year substantially reduced graduation rates. This led to a change in university policy to one that requires students to declare a major before they register for their 61<sup>st</sup> credit hour.

**TABLE 2: Students Completing Two Years – Major Change Activity and Graduation Rates**

<u>Sequence Code</u>	<u>Student Count</u>	<u>Graduation Rate</u>
DNNN	2,033	72.8%
DCNN	194	76.3%
DNCN	358	72.3%
DNNC	263	67.3%
XUNN	124	83.1%
XNUN	317	86.1%
XNNU	306	80.7%
XNNN	696	62.6%
Total	4,291	72.8%

## **Study #2: Early Foreign Language Completion and Graduation Rates**

To earn a bachelor's degree, students at WKU must complete a second semester course in a foreign language (or demonstrate equivalent proficiency on an exam). The Modern Languages Department offers courses in Arabic, Chinese, French, German, Japanese, Russian, Spanish, and Swahili. The university encourages students to complete this requirement early in their undergraduate careers, but many students defer the foreign language until they are juniors or seniors.

Upon request of the Modern Languages department, Institutional Research conducted a longitudinal study of bachelor's degree seeking undergraduates, five years of starting cohorts from the fall of 2003 through the fall of 2008, producing a population of approximately 13,000 students. The fundamental research question: Does completion of the foreign language courses during the first two years of study have an impact on graduation rates? Simple statistics showed that the student who completed the language requirement within the first two years had a graduation rate of 67% compared to a graduation rate of 40% for those who did not.

This analysis illustrates the necessity to have institutional awareness when conducting studies of this kind. WKU has an Honors College that admits students with strong academic backgrounds. The college dedicates sufficient openings for these students so they can begin foreign language courses during their freshmen year. As a result, all honors students are within the group who complete the foreign language requirement early, and honors students have very high graduation rates. Their inclusion in the study would produce misleading results.

Further, the fall-to-fall retention for first time freshmen at Western Kentucky University is approximately 73%. If one simply distinguishes students who completed a foreign language during the first two years from those who did not, one introduces a bias since completion of a course during the second year includes only those students retained after year one. For this reason, an analysis comparing the

graduation rates of those who did / did not complete the language requirement in the first two years must eliminate the students who were not retained after the first year.

Further, as measured by high school GPA and ACT scores, stronger students tend to complete the language requirement earlier. To account for this and the factors above, the study used the population of starting freshmen, excluding honors students, who were retained to the second year. This reduced the population for the study to 8,478 students, but the population is now suitable for a strong comparison between students based upon early foreign language completion. The research conducted a linear regression on graduation (dependent variable) with three independent variables: 1) completion of the language requirement in the first two years, 2) ACT composite score, and 3) high school GPA. After controlling for these factors, students who completed the foreign language within the first two years had a 10% higher probability of graduating. The data support the assertion that the skills acquired while learning a foreign language contribute to overall academic performance.

### **Study #3: Fraternity Involvement in a General Education Course**

While working one Saturday the head of a Department noticed a group of students in a classroom being tutored by a faculty member. This was not a Saturday class on the official schedule. He noticed that the students appeared to belong to the same fraternity. After some reflection, the department head contacted Institutional Research and requested information on fraternity participation. He asked for the overall percentage for the university and then specific statistics on the levels of fraternity membership in a specific general education course broken out by the faculty teaching it each semester.

Overall fraternity membership for undergraduate men at WKU remains rather steady at approximately 11.5%. An examination of the courses yielded the following results.

**Table 3: Fraternity Membership in General Education Course ABC by Instructor**

<b>Instructor</b>	<b>Fall 10</b>	<b>Spring 11</b>	<b>Fall 11</b>	<b>Spring 12</b>	<b>Fall 12</b>	<b>Spring 13</b>
A	12%	7%	9%	10%	11%	10%
B	8%	10%	8%	12%	14%	19%
C	11%	9%	12%	12%	8%	10%
D	13%	12%	13%	13%	13%	11%
E	11%	10%	15%	17%	20%	27%
F	12%	8%	10%	11%	10%	9%
G	9%	12%	10%	9%	10%	11%
H	12%	11%	12%	13%	11%	11%

As can be seen in Table 3, most of the courses have fraternity membership levels consistent with that of the university. However, two instructors, B and E, have levels trending upwards and well above the university average. An investigation discovered that Professor E had a relationship with one of the fraternities on campus and had agreed to provide study sessions on certain weekends during the semester. The department head asked if the sessions were known and available only to the fraternity members. The professor insisted that the weekend tutoring was available to all students in the course. The session schedule was indeed published on Blackboard (an online class management system where professors can publish information available to all students enrolled in particular course). Further

discussion with Dr. E satisfied the department head that his relationship with the fraternity was benign if not actually beneficial for the students involved. No specific circumstance existed for the rise in fraternity percentages with professor B, other than strong student evaluations and his general reputation as an excellent instructor.

### **Study #4: Modern Languages Second Semester Courses**

In one of the languages taught within the Modern Languages Department, the department head responded to data collected from the student course evaluations as well general concerns she had heard regarding the faculty. To gain a deeper insight into what was occurring in the classrooms, the department head wished to examine the grade distributions for each faculty member in the second semester classes in this language. Most of the student evaluations suggested that instructor T and professors V and Y were popular, although student responses to “I have learned a lot in this course” were significantly lower for T, and some of T’s students had written in the comment field that they had learned very little in the class. Evaluation results slammed Professor X as a teacher to be avoided.

Experience showed that in general approximately 80% of students in the course earned a grade of C or better. Table 4 shows the results of combining three semesters of grades for each of the faculty teaching the course. As suggested by the student evaluations, X’s grade distribution demonstrated a problematic situation warranting intervention. T, Y and V had similar grade distributions with T having most the generous, awarding A’s to 50% of the students while the other two awarded 39% A’s. All three had low failure rates.

**TABLE 4: Language 102 Course Grades by Instructor**

<b>Instructor</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>F</b>	<b>W</b>
S	28%	29%	24%	7%	5%	7%
T	50%	29%	14%	5%	2%	2%
V	39%	31%	18%	7%	3%	2%
W	31%	29%	17%	7%	7%	8%
X	3%	7%	24%	20%	25%	22%
Y	39%	33%	17%	4%	3%	4%
Z	36%	29%	21%	5%	8%	2%
<b>TOTAL</b>	<b>32%</b>	<b>28%</b>	<b>20%</b>	<b>7%</b>	<b>7%</b>	<b>7%</b>

The Department Head then examined the subsequent course (Language 201) participation by the students completing the second semester courses (see Table 5), and deeper insights followed. Upon completion with T or Y, only 9 % (8 % respectively) of students elected to continue learning the language, and of those that did, only 33% (36%) earned an A or B in the next course. With V and Z, however, 34% (28%) of students continued to the second year courses and performed well (81% and 74% earning an A or B).

The numbers supported the notion that V and Z were exemplary and popular language instructors who instilled enthusiasm for the subject, while T and Y were seen as “easy teachers” to take for completion of the general education requirement, but not for effective learning of the language. Not surprisingly, few of X’s students chose to continue in the program, but those who could survive his course would succeed if

they did. Equipped with this data and other analyses, the department head was able to meet with faculty and take corrective action.

**TABLE 5: Second Semester Language Fall 2010 to Spring 2012**

Instructor	All Students	Students (A/B/C)	Continue in Language	A/B Next Course
S	399	276 (67%)	39 (12%)	30 (78%)
T	133	122 (92%)	10 (9%)	3 (30%)
V	246	216 (88%)	73 (34%)	59 (81%)
W	286	222 (78%)	40 (18%)	28 (70%)
X	185	63 (34%)	5 (8%)	5 (100%)
Y	308	273 (89%)	22 (8%)	8 (36%)
Z	160	137 (86%)	38 (28%)	28 (74%)
ALL	1717	1355 (79%)	227 (17%)	161 (73%)

### Study #5: High School Dual Credit Chemistry and Graduation Rates

Over several years the Chemistry Department at Western Kentucky University developed a partnership with more than 20 high schools in the region to develop a year-long chemistry course to be taught in the high schools including well equipped laboratories for chemistry experiments. In addition to providing quality instruction and college level sophistication at the high school level, supporters believed that students would retain additional academic skills and attitudes that would lead to greater success upon enrollment in college. How does a high school chemistry program offering college credit impact future student success in college?

In the period of the study 611 students came to WKU after having participated in the dual credit chemistry courses in high school. The fall-to-fall retention rate for these students exceeded 85% while the university average is 73%. However, high school students in this region who elect to take a chemistry course offering college credit naturally tend to be stronger students, which could explain the higher retention rate. To control for student ability, the study disaggregated the students by ACT composite score. Grouped by ACT scores, students who completed the chemistry program were compared with those who did not.

Table 6 provides an example of a situation where the data is presented to a customer in an easily understood format that does not involve statistical calculations. While the analysis continued with a linear regression, table 6 shows students with the same ACT scores broken out by participation in the chemistry course and the corresponding graduation rates. The interpretation requires no mathematics and is accessible to high school sophomores inquiring about the program.

A linear regression on fall-to-fall student retention based on participation in the chemistry program, controlling for ACT composite scores, found that students having participated in the program had a 10 % higher retention rate.

For graduation rates, the results were even stronger, with the chemistry students graduating at a rate of 71% vs. 51% for the students who did not. Table 7 shows the linear regression results for six-year graduation. Controlling for ACT composite score, the students having taken the dual credit classes had a



13.5% higher probability of graduating. Table 8 shows the students grouped by ACT score with the graduation rates for those having taken (or not) the dual credit chemistry program.

**TABLE #6: Retention Rates by Dual Chemistry Participation and ACT Composite**

ACT Composite Score	Dual Chemistry Participation	Fall-to-Fall Retention Rate
17	No	62.6 %
	Yes	100 %
18	No	65.3 %
	Yes	73.9 %
19	No	66.7 %
	Yes	66.7 %
20	No	66.3 %
	Yes	89.7 %
21	No	72.7 %
	Yes	79.3%
22	No	72.1 %
	Yes	88.7 %
23	No	74.7 %
	Yes	92.0 %
24	No	76.7 %
	Yes	82.8 %
25	No	77.0 %
	Yes	87.7 %
26	No	79.0 %
	Yes	89.3 %
27	No	83.7 %
	Yes	92.3 %
28	No	85.6 %
	Yes	84.6 %
29	No	85.1 %
	Yes	88.3 %

**TABLE #7: Linear Regression – Dependent Variable: Six-Year Graduation**

Parameter	$\beta$	Std. Error	t Value	Pr >  t
Intercept	- 0.1590	0.0282	- 5.65	< 0.0001
Chemistry Program	0.1353	0.0270	5.00	< 0.0001
ACT Composite	0.0310	0.0013	24.38	< 0.0001

**TABLE #8: Six-Year Graduation Rates by Dual Chemistry Participation and ACT Composite**

ACT Composite Score	Dual Chemistry Participation	6-Year Graduation Rate
17	No	34.8 %
	Yes	100 %
18	No	40.3 %
	Yes	61.5 %
19	No	43.8 %
	Yes	50.0 %
20	No	42.7 %
	Yes	69.0 %
21	No	52.6 %
	Yes	61.1%
22	No	53.0 %
	Yes	78.4 %
23	No	57.9 %
	Yes	78.6 %
24	No	59.2 %
	Yes	67.6 %
25	No	59.4 %
	Yes	68.8 %
26	No	63.6 %
	Yes	78.8 %
27	No	66.4 %
	Yes	69.6 %
28	No	72.9 %
	Yes	85.0 %
29	No	70.0 %
	Yes	78.6 %

## CONCLUSION

Effective institutional research offices offer far more than statistical analyses and data reporting. Over years the researchers develop a deep understanding of the data and the processes associated with the full pipeline of student participation in higher education, from the early recruiting efforts of enrollment management departments to the processing of student applications followed by enrollment into courses and finally graduation. Institutional researchers must understand relationships and other dynamics between the colleges and degree programs to properly frame and construct the data analysis to address a wide variety of research questions, identifying the appropriate populations and taking into account factors that could produce misleading results,

Institutional Research professionals also understand their audience and the need to produce information in a form that can be understood by their customers, which in most cases are not statisticians. With a well- designed data infrastructure and expertise in statistical programming, IR can refute anecdotal myths (“Students are taking forever to graduate because they keep changing their majors!”) and uncover unexpected issues (over 25% of elementary Spanish students are seniors). By helping deans and departments clarify their questions and focus their inquiries on the key issues they wish to understand, Institutional Research helps deepen the understanding of university administrators and works with them to identify solutions and improvements for the organization.

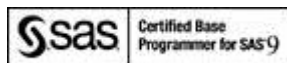
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## CONTACT INFORMATION

Matthew Foraker  
Research Coordinator  
Western Kentucky University  
1906 College Heights Blvd.  
Bowling Green, KY 42101  
270-745-3250  
[Matthew.foraker@wku.edu](mailto:Matthew.foraker@wku.edu)



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