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Statistical Analysis of 1890 Land-Grant Universities Future Undergraduate Fall Enrollment Using Time-series From 1996 to 2018

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ABSTRACT

Background: The 19 historically black universities legally participated in the land-grant system by the passage of the Second Monill Act of 1890. The Second Monill Act of 1890 was signed to maintain the land-grant funds equally distributed for all races. African American students were far behind other students in the agricultural field of education and professions. 1890 Land-Grant Universities College of Agriculture plays an important role in keeping the diversity in the agricultural field. However, measuring the development growth seemed important to increase the enrollment pattern of these colleges continuously. to educate and build careers in agriculture, food, natural resources, and human sciences. ***Purpose:*** This paper identifies the nature of the phenomenon represented by the sequence of observations, and predicts future values of the college of agriculture's undergraduate fall enrollment trends of all the 1890 land-grant universities. ***Method:*** This research work is carried out on the number of reported undergraduate fall enrollments of the college of agriculture for 18 land-grant universities. A period of 23 years (1996 to 2018) is considered. A time series analysis was performed on this data. ***Result:*** The most significant output result of the study is that among the 18 universities, eight universities are highly expected to increase the enrollment number of students, two universities are highly potential for losing students in the future, and others have a relatively inconsistent growth rate. ***Conclusions:*** The paper concludes that the P-value indicates that the Time variable has some correlation with fall enrollment in the College of Agriculture in 1890, which is important for decision- making. Furthermore, most of the College of Agriculture at the 1890 Land Grant universities have a high potential for enriching its departments in the future. Colleges of Agriculture at the Land Grant Universities were established to improve higher agricultural education for minorities, especially African Americans. Urgent change is essential in agricultural education at 1890 institutions of higher education in the United States. This is critical to adequately educate and train students to address intricate and unprecedented environmental and human development issues and opportunities in a rapidly transforming global, scientific, and technological environment.

Keywords: enrollment; enrollment trends; trend analysis; 1890 land-grant universities; agricultural education; educational assessment

INTRODUCTION

According to an August 5, 2012, of USA Today, the demand for skilled workers in agriculture and related industries is growing rapidly, possibly in part because of the prediction that agriculture productivity will have to increase by at least 70% by 2050 to feed the world's growing population. The article claims that students are showing interest in the big problems of the day, such as food safety, global food security, and hunger in the developing world. Jones & Larke (2001) show that opportunities in agriculture and related careers are on the increase. USDA estimates that between 2010 and 2015 there will be 54,400 annual employment openings for individuals with baccalaureate or higher degrees within the agriculture, food, and renewable natural resources sectors which will create a larger demand for anticipated graduates with college degrees or related work experiences (Goecker et al., 2010). Mallory & Sommer (1986), Wildman & Torres (2001), and Scott & Lavergne (2004), however, show that despit growing opportunities for college graduates in these areas and the fact that demand for workers is on the increase, enrollment in colleges of agriculture nationally ccontinuesto decline. Data from the Food and Agricultural Education Information System (FAEIS) on 1890 colleges support this claim (Figure 1) showing a general decline since 2008 and a dramatic decrease between 2012 and 2013. With fewer students going into agriculture, the long-term future of the agricultural industry is in question. This decrease in enrollment has created profound effects on many institutions of higher education, especially 1890 land-grant institutions (Cotton et al., 2009), several of which have lost agricultural science programs due to low enrollment, lack of funds, and the need for program innovations (Lynch, 2001).

The consensus is that colleges of agriculture and the agricultural industry will face serious problems if the current trends are not soon reversed.

The 19 historically black universities legally participated in the land-grant system by the passage of the Second Monill Act of 1890. The Second Monill Act of 1890 was signed to maintain the land-grant funds equally distributed for all races. African American students were far behind other students in the agricultural field of education and professions. 1890 Land-Grant Universities College of Agriculture plays an important role in keeping the diversity in the agricultural field. However, measuring the development growth seemed important to increase the enrollment pattern of these colleges continuously. to educate and build careers in agriculture, food, natural resources, and human sciences.

Purpose: This paper identifies the nature of the phenomenon represented by the sequence of observations, and predicts future values of the college of agriculture's undergraduate fall enrollment trends of all the 1890 land-grant universities.

Hypothesis: The null hypothesis is that there is no serial correlation n.If DurWatsontson (DW) lies below *dL*, the authrejectsect the null hypothesis, and accepts the alternative hypothesis that there is positive autocorrelation.

The Durbin-Watson Test: The null hypothesis is

$H0$:ρ=0 if $d <$ or du>(4- du)
$H1$:$\rho \neq 0$ if d< (4- du)

The overview of the literature review, methodology section, and descriptive statistic sections was extracted from the paper entitled " Assessment and analysis of undergraduate Fall enrollment trends of the selected College of Agriculture at the 1890 Land-Grant universities: 1996 to 2018" published by the authors in vol 3, issue 5, Sept-Oct 2022, International Journal of Scientific Advances (IJSCIA).

AN OVERVIEW OF LITERATURE REVIEW

According to U.S. Census Bureau, the U.S. population will double by 2040 than 1990. Similarly, at the same time, the African American population has a similar growth rate(The Council of 1890 Presidents/Chancellors). Moreover, by the same time, African American students will be 15 percent of total U.S. college students compared to 9 percent in 1995. On the other hand, African American college students are supposed to increase 15 percent of the number of United States college students, whereas white students are expected to increase by 5 percent. The Council of 1890 Presidents mentioned that as African American students & minorities are far behind others, they should be given special attention. Furthermore, it was stated that the nineteen 1890 land grant universities could help them fulfill their need because these universities have diverse faculty. Social support networks positively influence minority undergraduate students' academic success-related outcomes, health, and well-being (Davis,1991). Whereas studying n PWI(predominantly white institutions), African Americans seemed less productive, less social, and stay to themselves, though by attending HBCUs, they have greater academic performances, stronger relationships with fellow students, professors, and advisors, more involved with organizations; and have a greater desire to succeed (Wardlow, Graham, & Scott, 1995).

Westbrook et al.(2007) commented that recruiters at 1890 land grant universities have to publicize their schools to increase the enrollment of African American students because these universities are smaller than others.

All agricultural educational programs aim to appreciate and understand knowledge, and skills related to the agricultural sciences, agribusiness, and the production and processing of food and fiber, quoted by Newcomb et al. (2010). But due to several reasons, African American students were less interested in taking these extremely important programs. To increase the enrollment of African Americans studying agricultural science, Westbrook(2007) developed recruitment & retention strategies and showed demographic characteristics of 1890 land grant university agricultural science administrators.

Retallick et al. (2008) aimed to examine the enrollment and participation trends of comprehensive agricultural programs. The author collected enrollment data from the year 1991 to 2005. By analyzing The U.S. Department of Education (ED) and the National Student Clearinghouse (NSC) annual reports on higher education fall enrollment, and student outcomes, Juszkiewicz(2017) found the decline of community college fall enrollment since 2010 and declination rate of older student's community college fall enrollment is the highest. However, the completion rates almost remain steady during this time. Another similar research, Zweben(2020), showed that total enrollment in U.S. computer science programs increased by 6.2 percent in 2008 over the last year, which is the first increase in total enrollment in computer science programs in six years. Notwithstanding, undergraduate enrollment increased, and degree completion decreased. It should be noted that there was less diversity in computer science undergraduate programs, such as two-thirds of students receiving bachelor's degrees were Whitand e, non-Hispanics, but in the case of Ph.D. completion, the total number increased by 5.7%.

Card and Lemieux(2001) showed the trends in school enrollment and completed schooling attainment and tried to figure out the underlying causes of these trends, such as the contribution of trends in the family background & the effect of local variables. Furthermore, card and Lemieux(2001) suggested that college entry rates and college-age enrollment rates were positively correlated with the returns to college for young workers. Volk(1993) examined the enrollment trends in technology teacher preparation programs. The author found significant changes in the number and type of degrees granted with industrial arts/technology education programs in five-year intervals from 1970 to 1990. Sharik et al. (2015) examined undergraduate enrollment from 1980 to 2012 in Natural Resource Programs in the United States and showed that enrollment trends were highly cyclical as well as varied for the field of study, gender, race, ethnicity, minorities, and other factors.

Davis and Bauman(2011) explained enrollment levels and trends in the population aged 3 and older based on data collected in 2008 by the U.S. Census Bureau in the American Community Survey (ACS) and the Current Population Survey (CPS). The report reveals enrollment declined by 0.7 million in Grades 1 through 12 from 2000 to 2008. On the other hand, college enrollment was at its all-time peak, and Hispanic student enrollment increased rapidly by this time. Baum and Payea(2011) discussed and proved the rapid growth of Postsecondary Education by analyzing data from 2009-2011. The authors also discussed other relevant factors tuition and fees, family incomes, and student aid.

Schafft(2014) examined and assessed enrollment trends of all Charter Schools in Pennsylvania based on race & socio-economic status and found out the financial impacts of these schools on assigned school districts for the academic years 2006-2007 through 2010- 2011. Garcia and Alvarez(2019) focused on enrollment inequities between Latinx undergraduate and graduate students for HSIs (Hispanic-serving institutions) by analyzing data from 10 years(2005-2015).

METHODOLOGY

With this study, the researcher analyzes and assesses 10 years(1996 to 2018) of undergraduate fall enrollment data for the College of Agriculture of 1890 Land-Grant universities. By exploring these data, the author examined the following research question:

Research Question 1: What were the enrollment trends for the selected College of Agriculture at 1890 Land-Grant University undergraduate students between 1996 and 2018?

Data Sources and Measures: First, the researcher collected data from the Integrated Postsecondary Education Data System (IPEDS) website(https://nces.ed.gov/).mThen undergraduate fall enrollment data of the College of Agriculture of 1890 Land-Grant universities were extracted at two-year intervals from 1996 to 2018. The researcher extracted 18 university data, but one university data(Southern University) is unavailable at IPEDS but focused. the following 5 universities are Alabama A&M University, Florida A&M University, North Carolina A&T State University, Prairie View A&M University, and Tennessee State University.

To address the research question, line graphs. The primary outcome was line graph trends which explain the enrollment trends of the undergraduate fall enrollment data of the College of Agriculture of 1890 Land-Grant universities between 1996 to 2018.

DATA ANALYSIS AND RESULTS

TABLE 1: Descriptive Statistics.

N		Minimum	Maximum	Mean	Std. Deviation
YEAR	12	1996.00	2018.00	2007.0000	7.21110
AAMU	11	7.00	775.00	393.9091	240.30500
FLORIDAAM	12	55.00	854.00	552.1667	200.16304
NORTHCATSU	12	195.00	552.00	330.6667	110.89088
TENNESSSEESU	12	338.00	449.00	385.4167	32.97784
PR4AIREVAMU	12	281.00	658.00	417.1667	109.78560
Valid N (listwise)	11				

Based on table 1 above, there are 12 valid values of Florida A&M, North Carolina A&T, Tennessee State, and Prairie View A&M of undergraduate enrollment, while Alabama A&M is 11 valid values of undergraduate enrollment. The minimum and maximum UG enrollment at the 1890 land grant university of the five selected were the Alabama A&M minimum value of 7, the maximum value of 775, and the mean value of 393.909. For Florida A&M, the minimum value is 55 and the maximum value is 854 with a mean value of 552.167, while the North Carolina A&T State minimum value is 195, the maximum value is 552 and the mean value is 330.667. The minimum value of Tennessee State is 338 while the maximum value is 449 and the mean value is 385.417. For Prairie View A&M, the minimum value is 281, the maximum value is 449, and the mean value is 417.167. Furthermore, the standard deviations for Alabama A&M were 7.211, Florida A&M was 200.163, North Carolina A&T 110.890, Tennessee State 32.977, and Prairie View A&M 109.785. It means the data is relatively distributed near the value.

LINE GRAPH RESULTS

(1) Alabama A&M University

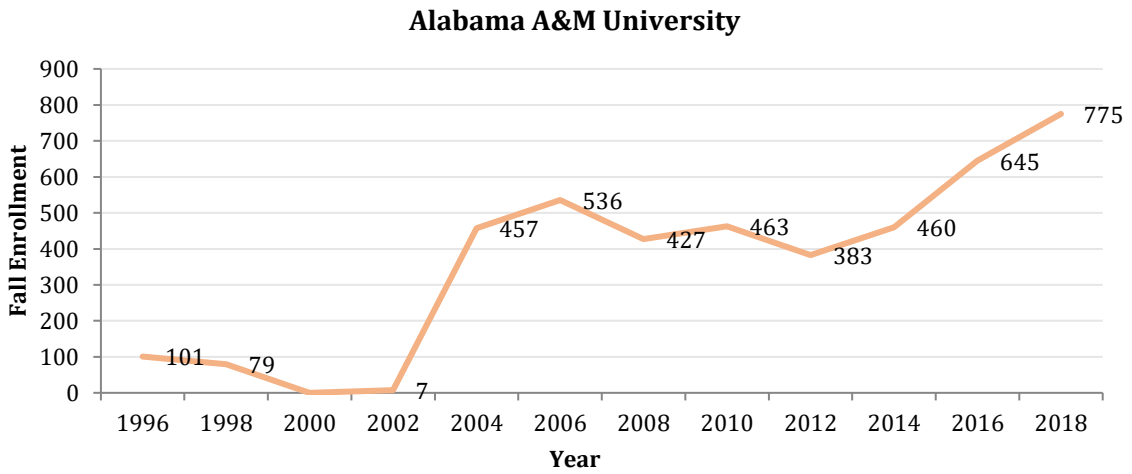

FIGURE 1: Line graph of the fall enrollment of the College of Agriculture at Alabama A&M University from 1996 to 2018.

Figure 1 shows that fall enrollment from 1996 to 2002 went down from 101 to 7. But then from 2002, it rose to 536 in 2006. Then again, it fell to 427 in 2008 and increased in 2010 to 463. After that, it dropped to 383 in 2012. From 2012 to 2018, the number of students enrolled in the fall rapidly increased from 383 to 775.

(2) Florida A&M University

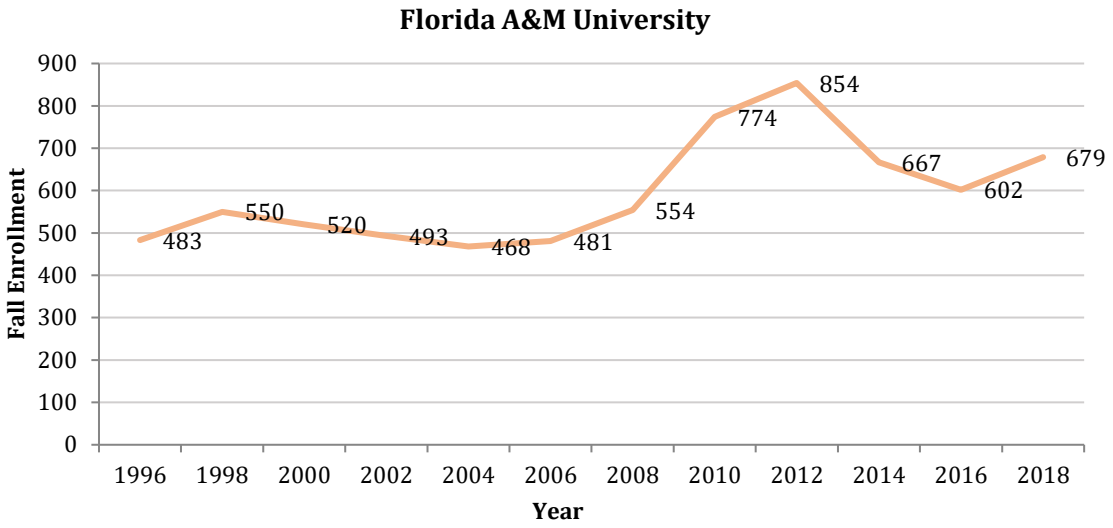

FIGURE 2: Line graph of the fall enrollment of the College of Agriculture at Florida A&M University from 1996 to 2018.

Figure 2 shows that from the year 1996 to 1998, fall enrollment increased from 483 to 550. After that, it gradually decreased to 468 in 2004. Then it soared to 854 in 2012. But then it gradually decreased to 602 in 2016. Though in the year 2018, it increased to 679 in 2018.

(3) North Carolina A&T State University

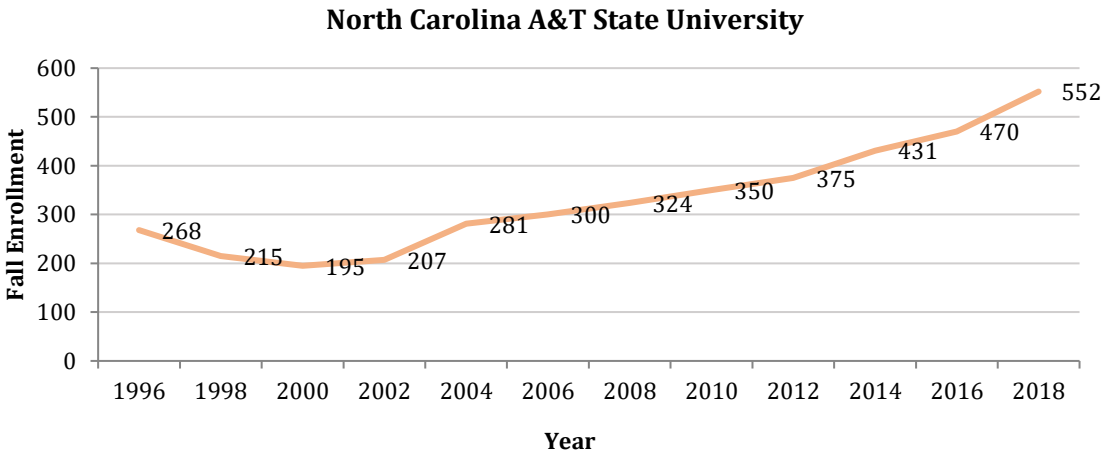

FIGURE 3: Line graph of the fall enrollment of the College of Agriculture at North Carolina A&T State University from 1996 to 2018.

Figure 3 shows that from the year 1996 to 2000, fall enrollment decreased from 268 to 195. Then from 2000 to 2018, it gradually increased from 195 to 552.

(4) Prairie View A&M University

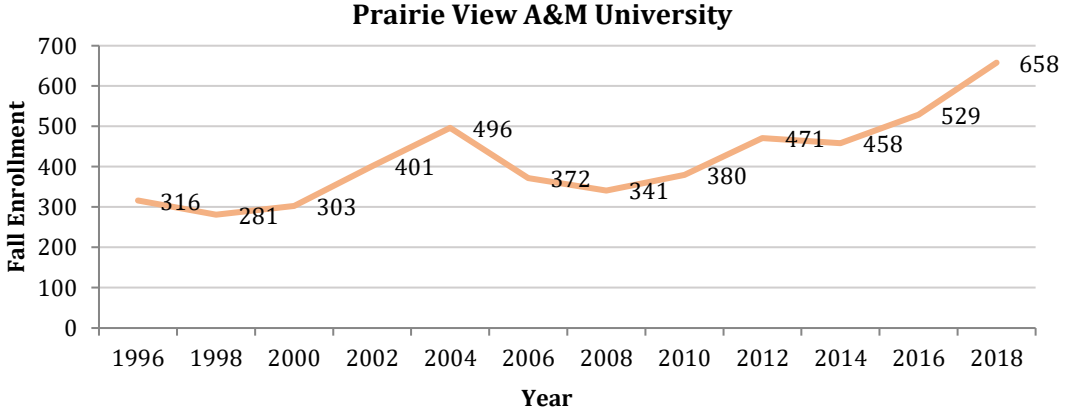

FIGURE 4: Line graph of the fall enrollment of the College of Agriculture at Prairie View A&M University from 1996 to 2018.

Figure 4. shows that fall enrollment decreased from 316 to 281 from the year 1996 to 1998. After that, from 1998 to 2004, it rose to 496. Then the enrollment slowly reduced to 341 in 2008. After the year 2008, the number fluctuated a little bit but climbed to 658 in 2018.

(5) Tennessee State University

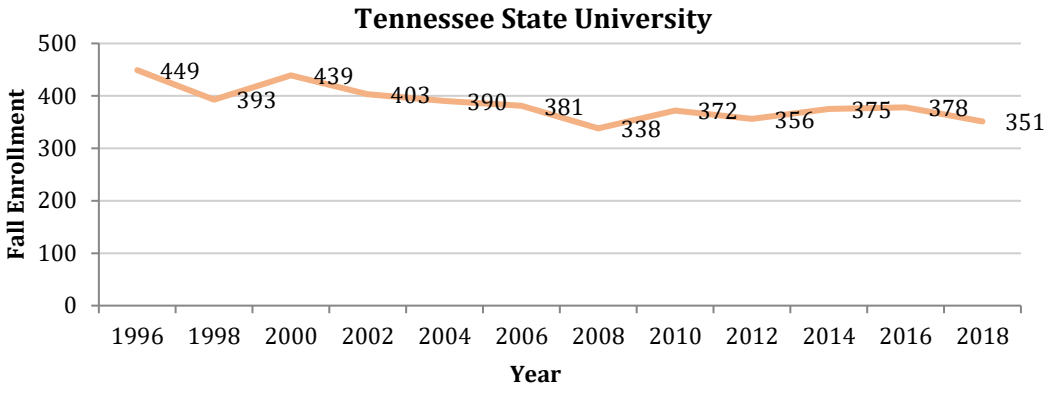

FIGURE 5: Line graph of the fall enrollment of the College of Agriculture at Tennessee State University from 1996 to 2018.

Figure 5 shows that fall enrollment fluctuated a lot from the year 1996 to 2018. First, it decreased from 449 to 393 in the year 1998. Then it rose to 439 in 2000. Similarly, after several increments and decrements from 2000 to 2018, enrollment finally reached 351 in 2018.

MODEL SUMMARY AND RESULTS

(1) Alabama A&M University

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.853[a]	.728	.697	132.22602	1.682

a. Predictors: (Constant), YEAR

b. Dependent Variable: AAMU

In the model summary table above the variation in Time (Year) explains about 69.7% of the variation in fall enrollment at Alabama A&M University.

The above table also reveals that the DW calculated = 1.682. It shows that the calculated DW above critical dL = 1.08 and du = 1.36, hence the author accept the Null hypothesis there is no statistical evidence that the data is positively correlated.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	420111.417	1	420111.417	24.029	.001[b]
	Residual	157353.492	9	17483.721		
	Total	577464.909	10			

a. Dependent Variable: AAMU

b. Predictors: (Constant), YEAR

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-56750.518	11657.653		-4.868	.001
	YEAR	28.464	5.807	.853	4.902	.001

a. Dependent Variable: AAMU

In the coefficients table above the fall, enrollment is predicted to increase when Time (Year) increases, both the constant and the coefficient on Time are highly significant at a 1% level, while the calculated F statistics and its significance suggest the whole equation is significant at the 5% level.

FE= -56750.5+28.46(T)-------- Equation (1)
Adj Rsquare = .697 Fcalc=4.03 Sig= .001

Where,
FE= Fall enrollment of the College of Agriculture at AAMU
T= Time

(2) Florida A&M University

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.375[a]	.140	.054	194.63432	1.989

a. Predictors: (Constant), YEAR

b. Dependent Variable: FLORIDAAM

In the model summary table, the R-square also called the coefficient of determination is very useful. to measure the proportion of the total variation in Florida A&M University Fall Enrollment (FE) about its mean explained by the regression of Fall Enrollment on Time. In this case, the regression only explains 14 % of the variation in the FE. Typically, values of R-Square below 0.2 are considered weak, between 0.2 and 0.4, moderate, and above 0.4, strong. A value of .14 is considered weak.

One can see from the Florida A&M model summary that the DW calculated = 1.989. It shows that the calculated DW above critical dL = 1.08 and du = 1.36, hence du = 1.36 less 1.989 less (4-1.36 =2.64) the author accepts the null hypothesis of no autocorrelation.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	61892.483	1	61892.483	1.634	.230[b]
	Residual	378825.184	10	37882.518		
	Total	440717.667	11			

a. Dependent Variable: FLORIDAAM

b. Predictors: (Constant), YEAR

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-20324.844	16333.203		-1.244	.242
	YEAR	10.402	8.138	.375	1.278	.230

a. Dependent Variable: FLORIDAAM

FE= -20324.844+10.402 (T)-------- Equation (2)

Adj Rsquare = .054 Fcalc=1.634 Sig= .230

Where,
FE= Fall enrollment of the College of Agriculture at Florida A&M

T= Time

The table provides information about the effects of the Time predictor variable. The unstandardized coefficient for Time is 10.40, which indicates that for the year of recruitment fall enrolments predicted will increase by 10. By examining the t-statistic for the variable, Time, one can see that it is associated with a significance value of .230 indicating that no statistically significance. The negative constant coefficient in the table above reveals that the expected value of fall enrollment will be less than 0 when Time is set to 0.

(3) North Carolina A&T State University

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.926[a]	.857	.842	44.01054	.784

a. Predictors: (Constant), YEAR

b. Dependent Variable: NORTHCATSU

The value of .857 indicates that 85.7% of the variance in the fall enrollment is explained by the Time in the model.

One can see from the North Carolina A&T State University's fall enrollment model summary that the DW calculated = 0.784.

It shows that the calculated 0.784 < 1.08 the author rejects the null hypothesis of no autocorrelation and accepts that there is positive autocorrelation of the first order.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	115895.392	1	115895.392	59.835	.000[b]
	Residual	19369.275	10	1936.928		
	Total	135264.667	11			

a. Dependent Variable: NORTHCATSU

b. Predictors: (Constant), YEAR

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-28237.505	3693.249		-7.646	.000
	YEAR	14.234	1.840	.926	7.735	.000

a. Dependent Variable: NORTHCATSU

FE=-28237.505 +14.234(Time)----------Equation (3)
Adj R-Squre = .621, Fcalc=59.835, Sig= .000

Where,
FE= Fall enrollment of the College of Agriculture at Florida A&M
T= Time

The above equation 3 means a strong positive correlation between the College of Agriculture at North Carolina A&T State University's fall enrollment between 1996 to 2018.

(4) Prairie View A&M University

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.810[a]	.655	.621	67.59377	1.273

a. Predictors: (Constant), YEAR

b. Dependent Variable: PR4AIREVAMU

The value of .655 indicates that 65.5% of the variance in the fall enrollment is explained by the Time in the model. One can see from Prairie View A&M University's fall enrollment between 1996 and 2018.

The model summary that the DW calculated = 1.273. It shows that the calculated 1.08 < 1.273 < 4-1.36=2.64) the author rejects the null hypothesis of no autocorrelation.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	86892.483	1	86892.483	19.018	.001[b]
	Residual	45689.184	10	4568.918		
	Total	132581.667	11			

a. Dependent Variable: PR4AIREVAMU

b. Predictors: (Constant), YEAR

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-24319.459	5672.293		-4.287	.002
	YEAR	12.325	2.826	.810	4.361	.001

a. Dependent Variable: PR4AIREVAMU

FE-24319.459+12.325 (Time)----------Equation (4)
Adj R-Squre = .842 Fcalc=19.018 Sig= .001

Where,
FE= Fall enrollment of the College of Agriculture at Florida A&M
T= Time

The above equation 4 shows the College of Agriculture at Prairie View A&M University's fall enrollment between 1996 and 2018 is predicted to increase as Time increases.

(5) **Tennessee State University**

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.762[a]	.580	.539	22.40262	2.058

a. Predictors: (Constant), YEAR

b. Dependent Variable: TENNESSSEESU

In the model summary table, the R-square also called the coefficient of determination is very useful. to measure the proportion of the total variation in Florida A&M University Fall Enrollment (FE) about its mean explained by the regression of Fall Enrollment on Time.

In this case, the regression only explains 58 % of the variation in the FE. One can see from the Tennessee State University falls in enrollment between 1996 to 2018. The model summary that the DW calculated = 2.058. It shows that the calculated 1.36 < 2.058 < 4-1.36=2.64) the author accepts the null hypothesis of no autocorrelation.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6944.142	1	6944.142	13.836	.004[b]
	Residual	5018.775	10	501.878		
	Total	11962.917	11			

a. Dependent Variable: TENNESSSEESU

b. Predictors: (Constant), YEAR

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7378.338	1879.969		3.925	.003
	YEAR	-3.484	.937	-.762	-3.720	.004

a. Dependent Variable: TENNESSSEESU

FE= 7378.338-3.484 (Time)----------Equation (5)
Adj R-Squre = .539 Fcalc=13.836 Sig= .003

Where,
FE= Fall enrollment of the Tennessee State University
T= Time

The above table reveals the Time variable, the coefficient tells us how much the Tennessee State University falls enrollment between 1996 to 2018 is expected to decrease when the Time variable increases by one year.

DISCUSSIONS

From table 1, it can be said that after several ups and falls, potential overall enrollments will be increased for 13 universities and decreased for 5 universities. Among them, eight universities are highly expected to increase the number of students, and two universities are highly potential for losing students in the future. North Carolina A&T State University had the most consistent positive growth rate, so from 1996 to 2018, North Carolina A&T State University's college of agriculture improved more than all other 1890 Land-Grant universities. Also, this college is the most potential because it continuously enriches its undergraduate student number by enrolling more students regularly. Besides, Alabama A&M University, Prairie View A&M University, has a high potential for future improvement because these enrollment increments are also consistent. On the other hand, Tennessee State University College of agriculture continuously lost its student from 1996 to 2018 and also had a medium negative growth rate and less potential.

CONCLUSION

The paper concludes that the P-value indicates that the time variable has some correlation with fall enrollment in the College of Agriculture in 1890, which is important for decision-making. Furthermore, most of the College of Agriculture at the 1890 Land Grant universities have a high potential for enriching its departments in the future. Colleges of Agriculture at the Land Grant Universities were established to improve higher agricultural education for minorities, especially African Americans. Urgent change is essential in agricultural education at 1890 institutions of higher education in the United States. This is critical to adequately educate and train students to address intricate and unprecedented environmental and human development issues and opportunities in a rapidly transforming global, scientific, and technological environment. It should be noted that agricultural education must keep pace with scientific progress as the magnitude of developments in the STEM fields allows shorter adjustment periods. Agricultural education and training must take into account new subject areas, innovative technologies, revamped pedagogies of education and instruction, and the fact that students of today have very different learning and communication styles. Issues such as sustainable agriculture, agricultural biosecurity, food security, availability and access, climate change, and biotechnology have become increasingly important to the agricultural sector, and thus to agricultural education. Colleges of agriculture must position themselves to continue making a formidable contribution to the sector.

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