Unemployment Rate and Tuition as Enrollment Predictors

Jamie DeLeeuw, Ph.D.

September, 2012

MONROE COUNTY
COMMUNITY COLLEGE
enriching lives

Abstract

An ARIMA (2, 1, 0) time-series model was created to determine whether unemployment rate and tuition predict total credit hour enrollment at Monroe County Community College over a span of 32 years. The model captured the Fall-to-Fall and Winter-to-Winter credit hour correlation and enrollment's positive linear trend; the autocorrelation parameter at Lag 2 was statistically significant. Using enrollment data to predict itself, 88.4% of the variation in enrollment was accounted for by the model. Adding unemployment rate increased the Stationary *R*-squared to .90, whereas tuition had no statistically significant relationship with enrollment. Both models were an excellent fit for the data. The benefits of using ARIMA for time-series analysis and enrollment forecasts for the upcoming semesters are included.

Unemployment Rate and Tuition as Enrollment Predictors

Given states' declining contribution to higher education subsidization (Grapevine, 2012) and thus greater reliance on tuition revenue (Delta Project, 2010), institutions are increasingly relying on enrollment projections to set tuition rates. The aim of college financial offices is to cover budgetary expenses without raising tuition to the point at which it deters students from enrolling. The present study examines the impact of cost per credit hour and local unemployment rate on community college enrollment.

To investigate the relationship between enrollment and tuition, previous studies have typically used the Student Price Response Coefficient (SPRC), the percentage change in enrollment given a fixed tuition increase (typically $100 or $1000) per year, or tuition elasticity of demand, the percentage change in enrollment given a percentage change in tuition. Tuition is considered elastic when demand for higher education varies as a function of a tuition adjustment, and inelastic when enrollment is not impacted by tuition modification. The enrollment numbers of public two-year institutions are generally more sensitive to tuition changes relative to four-year institutions given that they have a higher proportion of low-income and older students (Hearn, 1988; Leslie and Brinkman, 1987). For instance, upon incorporating data from nearly every state and subsequently controlling for unemployment rate and need-based grant spending per state, Kane (1995) found that a $1000 tuition increase (1991 dollars) led to a 3.5% decrease in enrollment at community colleges and a 1.4% decline at four-year institutions. Regarding community colleges specifically, and controlling for the same aforementioned variables, a less substantial increase of $100 (1993 dollars) resulted in a SPRC of -0.36, meaning enrollment decreased about one-third of one percent (Heller, 1996, as cited in Heller, 1997). Similarly, Rouse (1994) found a tuition increase of 8% led to a 0.9% decrease in enrollment and Shires

(1995) reported the demand price elasticity of California community colleges as -0.15. While studies have generally produced a slight inverse relationship between tuition increase and enrollment, as evidenced in Heller's (1997) meta-analysis as well as the aforementioned studies, others have found either the opposite effect or no effect (Craft, Baker, Myers, & Harraf, 2012; Shin and Milton, 2008).

Several studies have examined the relationship between unemployment and enrollment, with most demonstrating no relationship between the variables (Craft et al., 2012; Hemelt & Marcotte, 2011; Stanley & French, 2009). Kane (1995) however found that two-year public college enrollment was positively related to unemployment (as unemployment went up, enrollment went up), whereas four-year institutions' enrollment was inversely related (as unemployment went up, enrollment went down).

Gallet's (2007) meta-analysis of tuition elasticity indicates that a majority (72.5%) of tuition analyses use ordinary least squares (OLS). This method is problematic in that OLS assumes homoscedasticity and lack of autocorrelation in the residuals. College enrollment has been increasing over time, a factor that OLS is not equipped to handle with its minimization of the sum of squared errors (Tabachnick & Fidell, 2007). Regardless of the procedure used, analyses have tended to cover the short-run (91%), and correction for autocorrelation (28%), heteroscedasticity (7%), and multicollinearity (11%) has been rare (Gallet, 2007). In studies that include adjustments for autocorrelation and heteroscedasticity, enrollment is less affected by tuition increases (Gallet, 2007).

Autoregressive Integrated Moving Average (ARIMA) time-series analysis is an ideal way to examine enrollment patterns over time, test whether variables serve as predictors, and forecast future enrollment, while avoiding the previously mentioned statistical blunders. The selected model (p, d, q) characterizes patterns in the data: p = auto-regression, d = integrated (linear or quadratic trend), and q = moving average (random shocks). Integers in the model convey different meanings, with 0 indicating the element does not exist in the model. For instance, an integer in d indicates that the mean and variance over time are not constant and need to be made stationary through differencing or transformation before proceeding.

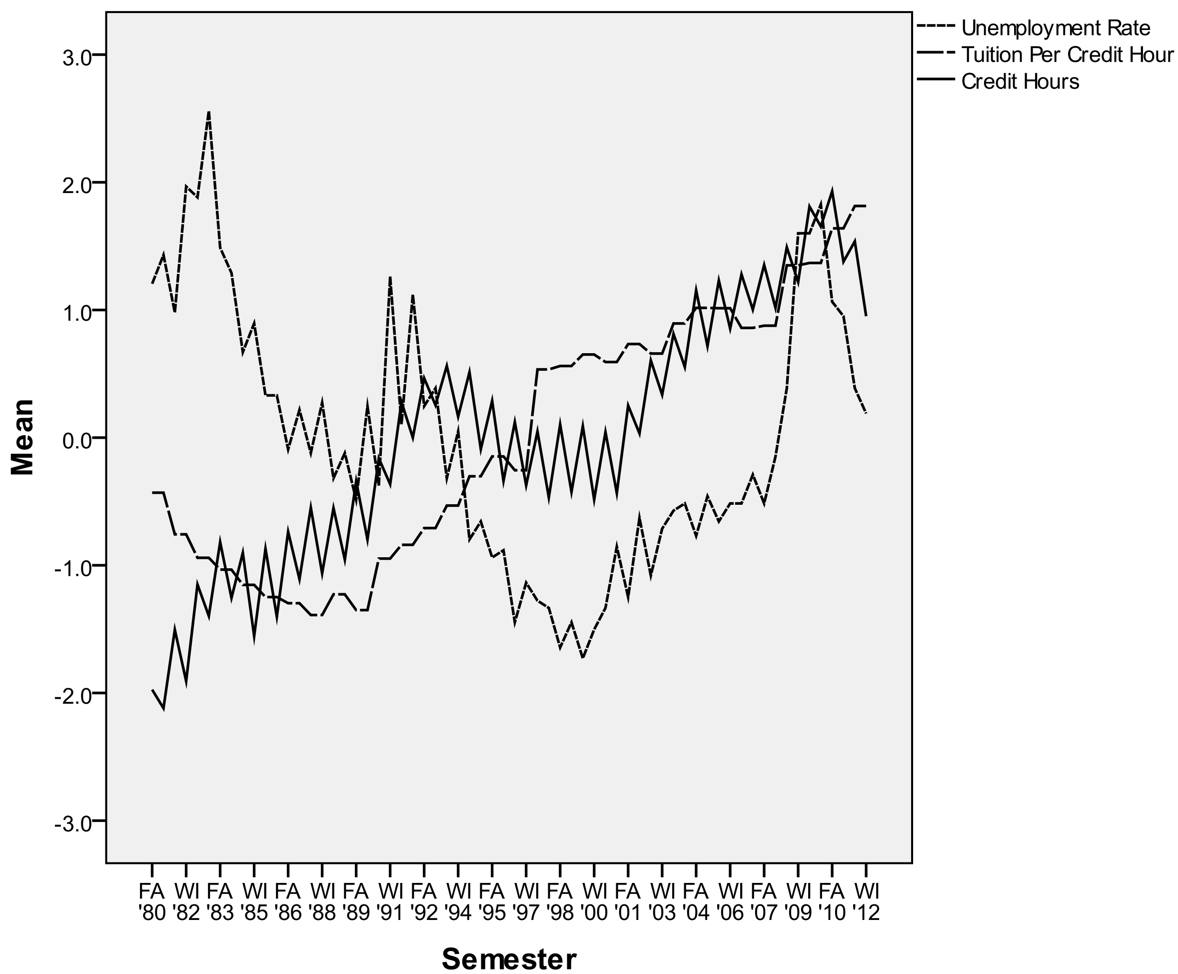
Method

A times-series model was created in SPSS to determine whether tuition and unemployment rate served as predictors of total credit hour enrollment at MCCC. Seasonal models were not included given that quarterly data were not used. Total credit hours and tuition data were acquired for Fall and Winter semesters, 1980 to 2012. Credit hours were not available for Winter semesters prior to 1991, so values were fitted based on a regression equation using headcount as the predictor; the correlation between headcount and total credit hours was .98. Tuition was defined as the cost per credit hour, including a technology fee. To control for inflation, all monetary values were converted to 2011 currency using the U.S. Inflation Calculator. County unemployment rate was acquired from the U.S. Department of Labor's Bureau of Labor Statistics; data were unavailable prior to Fall of 1990, so state information served as a substitute. There were no missing values in the data set.

Descriptive Results

Over the 64 time periods, the unemployment rate ranged from 2.3% to 17.5% (*M* = 8.4, *SD* = 3.7), tuition varied from $36.63 to $83 (*M* = 56.74, *SD* = 14.5), and credit hours ranged from 9948.1 to 42809.0 (*M* = 27145.5, *SD* = 8114.0). Converting raw data to z-scores allows one to examine all three trends simultaneously. Z-scores are standard deviation units from the mean. In terms of interpretation, scores around 0 are equal to the group mean for that particular variable, positive scores are higher than average, and negative scores are lower than average. Each z-score also corresponds with percentile scores. A score of +2 indicates that it is two standard deviations above the mean and is higher than 97.7% of the other values whereas a score of -2 indicates that it 2 standard deviations below the mean and is only higher than 2.3% of the other values, meaning it is quite low. Figure 1 illustrates that credit hours and tuition have increased over time whereas the unemployment rate has been more variable. The unemployment rate in Winter of 1983 (17.5%) was uniquely high.

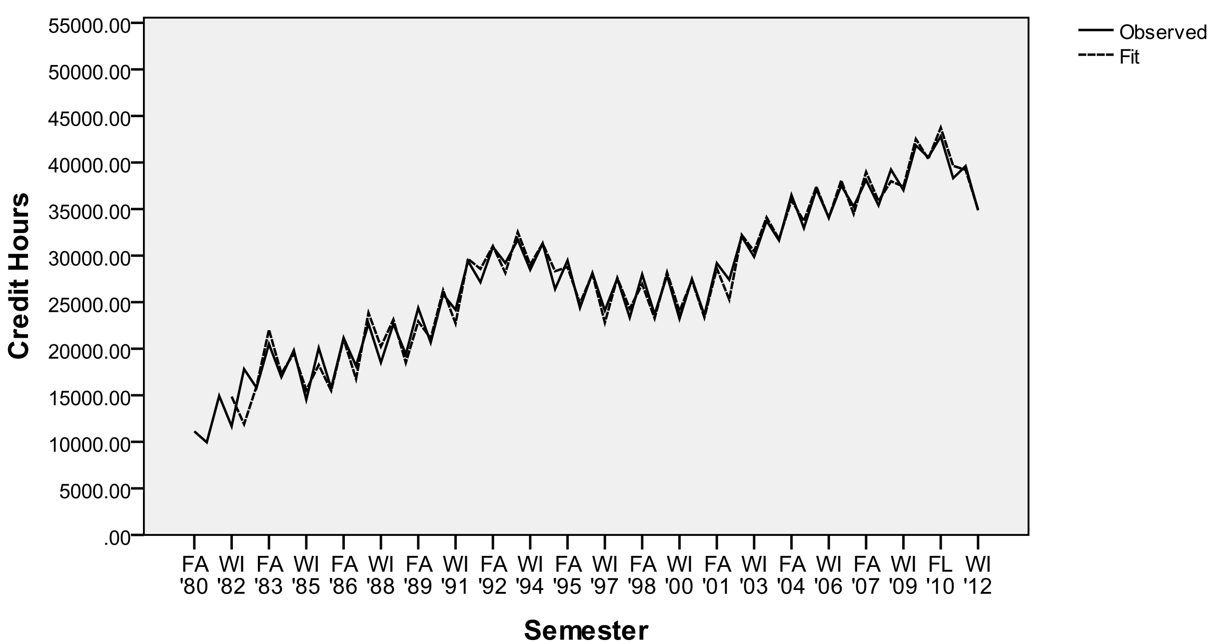
Figure 1. Z-scores of unemployment rate, tuition, and enrollment across 32 years.



Inferential Results

The SPSS Expert Modeler selected an ARIMA (2, 1, 0) model as the most appropriate fit for the data. The model captured the Fall-to-Fall and Winter-to-Winter credit hour correlation and enrollment's positive linear trend; the autocorrelation parameter at Lag 2, 0.98, was statistically significant, $t = 46.14$, $p < .01$. Unemployment was the only statistically significant predictor of enrollment, at Lag 0 and Lag 1, $t = 3.05$, $p < .01$ and $t = - 4.96$, $p < .01$, respectively. Differencing accompanied all statistically significant effects. The Ljung-Box Q statistic, .44, was greater than .05, indicating that the model was correctly specified, and the Stationary *R*-squared, .90, indicates that 90% of the variation in enrollment is explained by the model. The mean absolute percentage error (MAPE) was 3.65%. Figure 2 demonstrates the model's excellent fit with the data.

Figure 2. Predicted vs. observed credit hours from 1980 to 2012.



To demonstrate the positive linear relationship between unemployment rate and credit hour enrollment, a "what-if" analysis was conducted using 4%, 13%, and the actual forecasted unemployment rate figures for the next four time periods. Table 1 illustrates the results. For each semester beginning with Winter 2013, enrollment went up slightly as unemployment rate increased.

Table 1. Forecasted Credit Hours as a Function of Unemployment Rate.

Unemployment Rate	FA '12	WI '13	FA '13	WI '14
4%	36298.8	30791.9	31165.0	27230.9
8.47-9.25%[a]	36298.8	31853.5	34081.7	30268.6
13%	36298.8	32931.1	36701.8	32767.6

a. Actual Forecasted Values

Upon removing unemployment rate as a predictor and relying on credit hour enrollment to predict itself, the model was still very good, although the Stationary R-squared decreased from .90 to .884 and the MAPE increased to 4.47%. The autocorrelation parameter at Lag 2 decreased to .95, $t = 27.75$, $p < .01$ and the Ljung-Box Q statistic was .55. Given that time-series models are typically used for forecasting, Table 2 illustrates the differences between relying solely on historical credit hour data to forecast enrollment versus adding forecasted unemployment to the model. As evidenced by the wider confidence intervals, enrollment projections were less accurate when unemployment rate was removed as a predictor.

Table 2. Forecasted Credit Hours Using Forecasted Unemployment as a Predictor.

	FA '12	WI '13	FA '13	WI '14
Forecast	36298.8	31853.5	34081.7	30268.6
UCL[a]	38115.9	34423.2	38497.2	35959.8
LCL[b]	34481.7	29283.8	29666.2	24577.4
Unemployment	8.47%	9.18%	8.56%	9.25%

a. Upper Confidence Level, b. Lower Confidence Level

Forecasted Credit Hours Using Credit Hours Only.

	FA ‘12	WI ‘13	FA ‘13	WI ‘14
Forecast	36100.1	31576.8	32751.2	28448.8
UCL	38438.3	34883.5	38385.7	35698.6
LCL	33762.0	28270.2	27116.7	21198.9

Discussion

The ARIMA model that used credit hour enrollment to predict itself over time was very good, and improved an additional 1.6% when county unemployment rate was added to the model. Results were similar to Kane’s (1995) in that credit hour enrollment grew slightly as the unemployment rate increased; individuals appear to seek education when jobs are scarce. Overall, 90% of the total variation in credit hour enrollment was captured by the model. We can be 95% confident that 2012 Fall enrollment will lie somewhere between 34481.7 and 38115.9, with the best estimate being 36298.8. For applied purposes, it is important that new data be added each semester to capture recent policy changes and trends, thereby increasing the accuracy of the forecast. If one wants to avoid overestimating enrollment to prevent going over budget, one might select the best enrollment estimate for the upcoming semester and then adjust for policy changes that are being newly implemented and likely to affect headcount. Alternatively, one might select the lowest predicted figure within the confidence interval and adjust accordingly.

Unlike most of the previous studies, tuition had no relationship with credit hour enrollment. This finding aligns with Gallet’s (2007) conclusion that controlling for autocorrelation and heteroscedasticity produces smaller tuition effects. MCCC routinely has one of the lowest tuition rates in the region, and students may become habituated to regular credit hour increases; after controlling for financial factors Shin and Milton (2008) found that colleges that are less expensive than nearby schools have slightly higher enrollment, and students are attuned to the price of tuition, but not reactive to a yearly increase. Leslie and Brinkman (1987) surmised that the following factors may have averted national enrollment declines as tuition has increased: small increases over time are less influential than a large increase, higher demand for education (the payoff is considered worth the extra money), enhanced marketing, and increased access for minority and non-traditional students.

Further, given that a larger financial aid package may compensate for tuition raises to some degree, the non-extant relationship between tuition and enrollment is unsurprising. Although students are not typically cognizant of their specific qualifying aid amount prior to making an enrollment decision, Heller's (1997) review of the financial aid literature, as well as Hemelt & Marcotte's (2011) more recent study indicate a positive relationship between amount of financial aid and enrollment, particularly among non-traditional students (Seftor and Turner, 2002). While financial aid was not included in this study due to the limited accessibility of historical information, recently submitted IPEDS data indicate that the percent of full-time first-time degree or certificate-seeking undergraduates who received federal grant aid at MCCC increased from 19% in 2002 to 40% in 2009; the average amount received increased from $3228 to $4462.

In addition to further studying financial aid's impact on enrollment, future research could examine whether gender moderates the relationship between unemployment rate and enrollment. Ewing, Beckert, & Ewing (2010) found that men tended to forego school during times of economic growth, measured via the Industrial Production Index, whereas women remained in attendance. It was noted that men may have received a disproportionate share of job offers during the economically fruitful periods. Women were also more likely to enroll in college when an unexpected rise in inflation occurred.

References

Center for the Study of Education Policy at Illinois State University. (2012). *Grapevine*. Retrieved from http://grapevine.illinoisstate.edu/tables/FY12/Revised_March13/Table%202%20Revised.pdf.

Craft, R. K., Baker, J. G., Myers, B. E., & Harraf, A. (2012). *Tuition revenues and enrollment demand: The case of southern Utah university* (Professional File No. 124). Retrieved from http://www.airweb.org/EducationAndEvents/Publications/Documents/124.pdf.

Delta Project on Postsecondary Education Costs, Productivity, and Accountability. (2010). *Who pays for higher education? Changing patterns in cost, price, and subsidies* (Issue Brief No. 1). Retrieved from http://www.deltacostproject.org/resources/pdf/issuebrief_01.pdf.

Ewing, K. M., Beckert, K. A., & Ewing, B. T. (2010). The response of US college enrollment to unexpected changes in macroeconomic activity. *Education Economics, 18*(4), 423-434.

Gallet, C. (2007). A comparative analysis of the demand for higher education: Results from a meta-analysis of elasticities. *Economics Bulletin, 9*(7), 1-14.

Hearn, J.C. (1988). Attendance at higher-cost colleges: Ascribed, socioeconomic, and academic influences on student enrollment patterns. *Economics of Education Review, 7*(1), 65-76.

Heller, D. E. (1997). Student price response in higher education: An update to Leslie and Brinkman. *The Journal of Higher Education, 68*(6), 624-659.

Hemelt, S. W., & Marcotte, D. E. (2011). The impact of tuition increases on enrollment at public colleges and universities. *Educational Evaluation and Policy Analysis, 33*(4), 435-457.

Kane, T. J. (1995). *Rising public college tuition and college entry: How well do public subsidies promote access to college* (Working Paper No. 5164). Retrieved from http://www.nber.org/papers/w5164.

Leslie, L. L., and Brinkman, P. T. (1987). Student price response in higher education. *Journal of Higher Education, 58*, 181-204.

Rouse, C. E. (1994). What to do after high school: The two-year versus four-year college enrollment decision. In R. G. Ehrenberg (Ed.), *Choices and consequences: Contemporary policy issues in education* (pp. 59-88). Ithaca, NY: ILR Press.

Seftor, N. S., and Turner, S. E. (2002). Federal student aid policy and adult college enrollment. *The Journal of Human Resources, 37*(2), 336-352.

Shin, J. C., & Milton, S. (2008). Student response to tuition increase by academic majors: Empirical grounds for a cost-related tuition policy. *Higher Education, 55*, 719-734.

Shires, M.A. (1996). *The future of public undergraduate education in California.* Santa Monica, CA: RAND Institute. Retrieved from www.rand.org/content/dam/rand/pubs/monograph_reports/2007/MR561.pdf.

Stanley, R. E., & French, P. E. (2009). Evaluating increased enrollment levels in institutions of higher education: A look at merit-based scholarship program. *Public Administration Quarterly, 33*(1), 4-36.

Tabachnick, B.G., & Fidell, L.S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Allyn & Bacon.