# A LONG-RUN CASE STUDY OF COLLEGE FOOTBALL ATTENDANCE

***Paul A. Natke, Central Michigan University***

## *Abstract*

*Regular season game-day data for a single college football team over 33 years are used to estimate attendance and attendance as a percent of stadium capacity. Two estimation methods with stationary variables are employed: ordinary least squares and two-stage least squares with instrumental variables. Results are consistent across estimation methods. Short-term team performance for home and visiting teams and the temperature all increase attendance measures. Some game-specific characteristics are also significant: conference games, televised games and non-Football Bowl Subdivision opponents reduce attendance while rivalry and homecoming games increase it. Economic variables, with the exception of travel cost, are insignificant.*

## INTRODUCTION

Game-day attendance has been studied at length across a wide variety of sports, across a large number of nations and across both amateur and professional levels. Many of these have employed cross-section data for a single season although some important factors driving attendance could change from year-to-year. Fewer studies have used panel data over short periods and no study has employed a time-series estimation process.

Price and Sen [2003] examined attendance at games in the Football Bowl Subdivision (FBS) using cross-section game-level data from a single season while Falls and Natke [2014] employed panel estimation methods across a multiple-year period using data from the FBS. Teams in the FBS are eligible to participate in over 40 bowl games after the end of the regular season and also are referred to as Division I-A. This is the highest division sponsored by the National Collegiate Athletic Association (NCAA).

The financial fortunes of many member schools of the FBS are tied directly to football attendance. For many athletic departments, football ticket sales are a primary source of revenue since teams outside the power conferences typically do not have lucrative television broadcasting contracts. Game attendance also supports other streams of revenue, such as parking fees and concession sales [Coates and Humphreys 2007; Krautmann and Berri 2007]. Revenue streams for

businesses in the local area also are augmented by fan attendance on game day [Baade et al 2008; Lentz and Laband 2009; Coates and Depken 2011; Huang and Dixon 2013].

A variety of indirect revenue streams are also generated by football game-day attendance in areas such as recruiting new students [Tucker 2005; Perez 2012]; a university's annual appropriations from the state government [Alexander and Kern 2010; Humphreys 2006]; and fund raising from alumni and other donors [Martinez 2010].

This study will contribute to the literature by estimating regression equations for game-day attendance and percent of capacity over a period of 33 years for a single team (Central Michigan University) using time-series methods. Although questions remain about whether the results of a case study can be universally applied to other teams, results may provide guidance for future empirical research and managerial decision making in college athletic departments.

## FBS FOOTBALL ATTENDANCE

Price and Sen [2003] examined all regular season games in Division I-A, now called the FBS, during 1997. They concluded that a wide variety of factors exerted a significant influence on game-day attendance including the home team's short-run and long-run performance, stadium capacity, student enrollment and the presence of a nearby professional team.

Falls and Natke [2014] employed a panel data set and an instrumented real ticket price to estimate attendance and percent of capacity regression equations for a regular season FBS games over a six-year period. Better team success (short run, medium term and long run) raise attendance measures. Higher undergraduate enrollment, traditional rivalries and video coverage increase percent of capacity used while poor weather, higher travel costs and larger local population decrease it. Fan interest wanes as a season progresses but this is offset as a team wins more games in a season. Games played near a National Football League (NFL) stadium, those with conference opponents, non-FBS opponents and opponents from the lower conferences in the FBS have lower stadium utilization. Real ticket prices and real income were insignificant for FBS teams.

## THE MODELS

Common methodological approaches to estimating attendance demand are to employ cross-section data for a group of teams in a single year or a cross-section of teams over a short period of time. Since both ticket prices and attendance are determined by the interplay between supply and demand there is an identification problem. This problem could be alleviated through the use of an instrumental variable. Previous studies typically use one of three methods to produce

coefficient estimates for the variables included in the demand equation: ordinary least squares, Tobit (to address a restricted dependent variable problem) or panel regression methods.

Time series regression methods attempt to identify those variables that are closely related to, or cointegrated with, the dependent variable over time. The time series approach has not been applied to college football attendance in the economic literature.

This study employs a conventional set of independent variables found in the football attendance literature. The attendance decision is treated as a cost-benefit calculation based on the expected marginal cost and the expected marginal benefit of attendance. Attendance for a specific game will be determined by economic variables, game-specific attributes, demographic characteristics and other factors.

The regression model takes the general form:

$$A_t = \alpha + E_t\beta + G_t\Psi + D_t\lambda + O_t\xi + e_t \quad (1)$$

where $A_t$ , $E_t$ , $G_t$ , $D_t$ and $O_t$ are sets of variables containing variables related to attendance, economic conditions, game specific attributes, demographic characteristics and other factors, respectively and $\alpha$, $\beta$, $\Psi$, $\lambda$ and $\xi$ are parameters to be estimated. The term $e_t$ is a residual with the usual white noise properties.

One model takes a time-series approach using standard tests will determine which independent variables are cointegrated with attendance and uses ordinary least squares methods to generate parameter estimates. A second model uses an instrumental variable technique to overcome the endogeneity problem: ticket price is instrumented with the state's real Gross Domestic Product and the real tuition rate.

One dependent variable is the official attendance figure as reported to the NCAA. The second is game-day attendance expressed as a percent of the stadium's official capacity. Stadium capacity can be exceeded for any specific game because of "standing room only" admissions. It should be noted that the Central Michigan University's (CMU) stadium capacity increased from 20,000 to 30,199 in 1997.

One economic factor is the state's annual real per capita disposable income. Game attendance is dominated by fans of the home team. Since a majority of the CMU alumni live in the state, it is assumed that Michigan's income measures are a good proxy for a home fan's budget constraint. Attendance is expected to be a normal good so the long-term trend of rising real incomes should increase attendance although Michigan experienced several business cycles over the sample period.

While mileage between campuses may be constant across years, travel costs per-mile can vary substantially as gasoline prices and vehicle fuel efficiency fluctuates. Visiting fans' travel cost for a specific game is calculated as the fuel cost of a round-trip driving a private automobile between campuses of the opponents. The average fuel efficiency rating of the U.S. vehicle fleet in each year is used to determine the number of gallons of fuel consumed and the weekly average price of unleaded gasoline in the Midwest is used to calculate the fuel cost. Greater real travel costs are expected to reduce attendance.

A third economic factor is ticket price. The ticket price is the nominal price for a single game general admission seat along the sideline adjusted for the price level using the monthly Consumer Price Index for Detroit. The real ticket price is expected to be inversely related to attendance. Over the earlier years of the study, ticket prices rarely varied across games in a season. In 1994, the athletic department began experimenting with differential prices for games based on the anticipated demand.

Students who pay a student activity fee in the Fall semester gain admission to football games at no additional charge. All students living on campus are required to pay this activity fee while students residing off-campus have the option to pay this fee. The marginal ticket price is virtually zero for many students.

Game specific variables make up the components of G. The model includes the "feels like temperature" (degrees Fahrenheit) which adjusts the average daily temperature for humidity and wind speed to provide a more accurate measure of a person's comfort level. The expectation is that colder "feels like" temperatures will discourage attendance among the "fair-weather" fans.

The number of a team's wins in a recent time period (the last four games) for both home and visiting teams may also be important determinants of attendance. More successful teams are expected to attract greater attendance.

The other influences on attendance (variable set O) include sets of dummy variables for "non-FBS opponent" (those from lower NCAA divisions) and games against CMU's strongest traditional rival Western Michigan University (WMU). A non-FBS opponent is expected to have a negative impact on attendance while a traditional rival should draw more fans to the game. Also included is a dummy variable (MAC) for a MidAmerican Conference game. Per previous empirical results, there is no expectation as to the sign of the conference variable.

Television broadcasting might be considered a substitute for game attendance particularly when weather is poor (a substitution effect). However, broadcasts are marketed widely by television networks prior to game day which could

stimulate fan interest (an advertising effect). Therefore, the impact of television broadcasts on game attendance remains unclear. The model employs a TV dummy variable which takes on the value of one if the game is transmitted via cable networks or open-access broadcast sources and zero otherwise.

The variable representing demographic characteristics (D) is undergraduate enrollment. Students represent the closest potential audience for a home game and enrollment is expected to exert a positive impact on attendance.

Table 1 displays sample statistics for the variables in the regression equations including nominal and real values for the monetary measures.

**TABLE 1**
**Sample Statistics**

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Attendance | 18,567 | 4,822.84 | 7,233 | 35,127 |
| percent of capacity | 78.39 | 27.06 | 23.92 | 143.16 |
| nominal ticket price (general admission) | $11.31 | 5.89 | $4 | $25 |
| nominal disposable income per capita | $21,338 | 7,754.09 | $8,893 | $33,672 |
| nominal travel cost | $49.60 | 48.62 | $8.33 | $240.28 |
| real ticket price (general admission) | $6.87 | 2.08 | $3.97 | $12.13 |
| real disposable income per capita | $13,631 | 1,680.00 | $10,072.04 | $16,175.56 |
| real travel cost | $32.14 | 30.34 | $6.88 | $200.43 |
| feels like temperature | 48.37 | 14.38 | 18.70 | 77.20 |
| Enrollment | 17,935 | 1,839.15 | 15,818 | 21,697 |
| CMU wins in last 4 games | 2.04 | 1.11 | 0 | 4 |
| opponent wins in last 4 games | 1.99 | 1.20 | 0 | 4 |
| TV | 0.14 | 0.35 | 0 | 1 |
| WMU | 0.06 | 0.24 | 0 | 1 |
| non-FBS | 0.13 | 0.33 | 0 | 1 |
| MAC | 0.50 | 0.50 | 0 | 1 |

Sample size = 175 games.

## EMPIRICAL RESULTS

Variables were tested to determine if they were stationary over the sample period using three standard tests: Dickey-Fuller, augmented Dickey-Fuller and Phillips-Perron. These test results are presented in Table 2. Real ticket price, real income

and enrollment were not stationary over the sample period so first differences were taken prior to these variables entering the regression analysis.

**TABLE 2**
**Unit Root Tests for Regression Variables**

| Variable | Dickey-Fuller Test | Augmented Dickey-Fuller Test | Phillips-Perron Test |
|---|---|---|---|
| Attendance | -8.71*** | -11.49*** | -11.44*** |
| percent of capacity | -7.84*** | -6.94*** | -6.91*** |
| real ticket price (general admission) | -2.74* | -1.71 | -1.10 |
| real disposable income per capita | -2.50 | -1.59 | -1.57 |
| real travel cost | -10.31*** | -14.46*** | -14.63*** |
| feels like temperature | -7.97*** | -11.66*** | -11.71*** |
| Enrollment | -1.36 | 0.30 | 0.63 |
| CMU wins in last 4 games | -6.52*** | -6.21*** | -5.98*** |
| opponent wins in last 4 games | -9.03*** | -12.99*** | -13.05*** |

*significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level

**TABLE 3**
**Johansen Co-Integration Tests for Percent of Capacity**

| Variable | Trace Statistic |
|---|---|
| real ticket price (general admission) | 9.08 |
| real disposable income per capita | 14.53* |
| real travel cost | 14.91* |
| feels like temperature | 14.67* |
| Enrollment | 5.77 |
| CMU wins in last 4 games | 14.76* |
| opponent wins in last 4 games | 25.32*** |

*significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level

It is a common to determine if variables are co-integrated over time before entering them in a long run time series regression equation. The Johansen co-integration test was conducted for each of the independent variables and percent of stadium capacity. Results of these tests are presented in Table 3 and indicate that the following variables are co-integrated with percent of capacity: real disposable income per capita, real travel cost, feels like temperature, home team

wins and opponent team wins. Real ticket price and enrollment are not co-integrated with percent of capacity.

**TABLE 4**
**Regression Results for OLS Models**

| **Dependent Variable** | **Attendance** | | **Percent of Capacity** | |
|---|---|---|---|---|
| | **Coefficient** | **Probability Value** | **Coefficient** | **Probability Value** |
| **Independent Variables** | | | | |
| change real ticket price (general admission) | -87.45 | 0.88 | 0.10 | 0.97 |
| change real disposable income per capita | 0.96 | 0.42 | 0.01 | 0.39 |
| change enrollment | 0.23 | 0.89 | -0.01 | 0.25 |
| real travel cost | -7.46 | 0.50 | -0.09 | 0.10 |
| CMU wins in last 4 games | **823.14** | 0.00 | 6.84 | 0.00 |
| opponent wins in last 4 games | **556.37** | 0.02 | 2.65 | 0.04 |
| average feels like temperature | **113.95** | 0.00 | 0.26 | 0.02 |
| TV | **1984.39** | 0.02 | -9.15 | 0.04 |
| MAC | **-3661.51** | 0.00 | -30.68 | 0.00 |
| WMU | **8064.38** | 0.00 | 30.84 | 0.00 |
| non-FBS | **-2859.04** | 0.01 | -16.71 | 0.01 |
| homecoming | **3123.02** | 0.00 | 13.25 | 0.00 |
| Constant | **11311.81** | 0.00 | 63.96 | 0.00 |
| F | 11.13 | 0.00 | 15.46 | 0.00 |
| adjusted R-squared | 0.41 | | 0.50 | |

Coefficients in bold are significant at the 5 percent level.

Ordinary least squares regression results are presented in Table 4. In the attendance regression, nine of the twelve independent variables included in the

model are statistically significant at the five percent level. None of the economic variables are statistically significant. Neither is enrollment. An additional win for the home or visiting team over the past four games increases attendance. Apparently fans are attracted to successful teams either home or visitor. Attendance also rises with temperature – a ten degree increase in temperature attracts over 1000 additional fans.

Game characteristics are important influences on attendance. Televised games (+1984) and homecoming games (+3123) attract more fans while MAC conference games (-3662) and those against non-FBS teams (-2859) attract fewer fans. The intensity of CMU's rivalry with Western Michigan is clear – these contests draw more than 8000 more people.

The percent of capacity regression equation (Table 4) displays similar results as those for attendance. Only one economic variable is significant at the ten percent level. The real travel cost coefficient suggests that a $10 increase in travel cost leads to a one percent reduction in percent of capacity used (200-300 people).

Most of the remaining coefficients are statistically significant at the five percent level and maintain the same signs. The lone exception is the television dummy variable's coefficient which switches sign (positive to negative) and remains significant. Noll (2011) suggests that an instrumental variable approach is necessary to accurately estimate attendance given the endogeneity of ticket price and attendance. Two-stage least squares results using an instrumental variables approach for ticket price are presented in Table 5.

Two-stage least squares estimates with robust standard errors. Change in ticket price is instrumented with change in Michigan real GDP and change in real tuition. Coefficients in bold are significant at the 5 percent level.

None of the economic variables are statistically significant in the two regression equations of Table 5. Studies of football attendance for college and professional teams have yielded inconclusive evidence on the impact of income. Welki and Zlatopper [1994] found that attendance at NFL games was an inferior good while Borland and Lye [1992] reached the same conclusion for professional football in Australia. Depken's [2001] results suggest, however, that attendance at NFL games is a normal good. Other studies of college football attendance either did not include income as an independent variable [Groza 2010] or found that income was not significant [Falls and Natke 2014]. Welki and Zlatopper's [1999] later study of NFL games also concluded that income did not affect attendance.

The real ticket price was insignificant in these regression models which is a common result for college football studies [Natke and Falls 2014; Price and Sen 2003]. A number of studies do not include a ticket price variable in their estimating equations [Eddy 2016; Groza 2010; Paul 2012].

**TABLE 5**
**Regression Results for Instrumental Variable Models**

| **Dependent Variable** | **Attendance** | | **Percent of capacity** | |
|---|---|---|---|---|
| | **Coefficient** | **Probability Value** | **Coefficient** | **Probability Value** |
| **Independent Variables** | | | | |
| change real ticket price (general admission) | -186.05 | 0.95 | -2.05 | 0.88 |
| change real disposable income per capita | 0.96 | 0.33 | 0.01 | 0.28 |
| change enrollment | 0.26 | 0.88 | -0.01 | 0.27 |
| real travel cost | -7.45 | 0.59 | -0.09 | 0.30 |
| CMU wins in last 4 games | **821.09** | 0.01 | 6.79 | 0.00 |
| opponent wins in last 4 games | **554.29** | 0.02 | 2.60 | 0.04 |
| average feels like temperature | **114.18** | 0.00 | 0.27 | 0.03 |
| TV | 1996.06 | 0.10 | -8.92 | 0.03 |
| MAC | **-3679.98** | 0.00 | -31.08 | 0.00 |
| WMU | **8144.88** | 0.00 | 32.59 | 0.01 |
| non-FBS | **-2878.12** | 0.03 | -17.13 | 0.02 |
| homecoming | **3130.33** | 0.00 | 13.41 | 0.00 |
| constant | **11314.11** | 0.00 | 64.01 | 0.00 |
| F | 15.25 | 0.00 | 20.23 | 0.00 |

Travel cost or travel miles for visiting fans have mixed results in the literature as it does in this study. Leonard [2005] found mileage and Falls and Natke [2014] found travel cost significant while Eddy [2016] found mileage insignificant.

This study's findings of no impact of economic variables on attendance could be caused by underlying factors that led to the conflicting conclusions among previous empirical studies. The findings could also result from unspecified factors unique to the CMU environment or the economy of Michigan. It simply

could be that economic factors are not important long run influences on college football attendance.

## SUMMARY

Regular season game-day data for a single team over a period of 33 years were collected to determine the long run determinants of attendance and attendance as a percentage of capacity. Data include measures of economic conditions, game specific attributes, demographic characteristics and other control factors.

Two estimation methods are employed: ordinary least squares with stationary variables and two-stage least squares using an instrumental variable approach to account for the endogeneity of ticket prices. Results generally are consistent across estimation methods. Both attendance and percent of capacity are stationary variables. Team performance measures for both home and opponent and the temperature increase each attendance measure. Conference games and non-FBS opponents reduce attendance while rivalry and homecoming games increase it. Evidence on the impact of televising games is contradictory. In the attendance regressions, television raises attendance while it lowers the percent of capacity used in the other model specification.

Home and visiting team performance, as measured by number of wins in the recent past, appear to be strong influences on attendance no matter how attendance is measured or which estimation procedure is used. If each team is riding a 4-game winning streak prior to a contest, attendance is predicted to rise by 5516 people (or 38% higher capacity utilization) than if both teams enter the contest on 4-game losing streaks. Games against the archrival team (Western Michigan) provide a large boost in attendance: over 8000 people or 31 percent of capacity used. CMU and WMU are members of the same conference. The net effect of this rivalry game is lower when the impact of the MAC variable is accounted for: a net gain of 4465 (8845-3680).

Visiting teams from lower divisions attract fewer people: about 2800 people or 17 percent of capacity. Decisions about scheduling teams from a lower division may cause some conflict: coaches and athletic directors may want these opponents to increase the probability of winning a game and becoming more attractive for postseason bowl games but can expect lower attendance and revenues on game day if they do. One possible caveat: at CMU non-FBS teams are more likely to be scheduled on or just prior to Labor Day weekend which may be a contributing cause for a negative coefficient.

A homecoming game attracts more people (over 3100 or 13 percent of capacity) and those against conference foes attract fewer people (nearly 3700 or 31 percent fewer). Perhaps more home fans are attracted to non-conference games for their novelty effect. Non-conference FBS visiting teams may boost attendance because

some of them are from "power five conferences" which may attract more home fans and a substantial cadre of visiting team fans.

The existence of rivalry and homecoming games is essentially outside the control of athletic administrators and coaches. However, fielding a winning home team, scheduling successful opponents and teams from the FBS appear to be effective cures for low attendance.

Some caution should be used in interpreting these results since this is a case study. Empirical estimation of attendance equations at other institutions and in other states could help determine if these results are specific to this case study or form part of a general pattern of behavior.

## REFERENCES


Alexander, D.L. and W. Kern. 2010. Does Athletic Success Generate Legislative Largess from Sports-Crazed Representatives? The Impact of Athletic Success on State Appropriations to Colleges and Universities. *Journal of Sport Finance*. 5: 253.

Baade, R.A., R.W. Baumann and V.A. Matheson. 2008. Assessing the Economic Impact of College Football Games on Local Economies. *Journal of Sports Economics*. 9: 628-643.

Borland, Jeff and Jenny Lye. 1992. Attendance at Australian Rules Football: A Panel Study. *Applied Economics*. 24: 1153-1158.

Coates, D. and C. Depken. 2011. Mega-events: Is Baylor Football to Waco What the Super Bowl is to Houston? *Journal of Sports Economics*.12: 599-620.

Coates, D. and B.R. Humphreys. 2007. Ticket Prices, Concessions and Attendance at Professional Sporting Events. *International Journal of Sports Finance*. 2: 161-170.

Cohen, C.; W. Whisenant and P. Walsh. 2011. The Relationship between Sustained Success and Donations for an Athletic Department with a Premier Football Program. *Public Organization Review*. 11: 255-263.

Depken, Craig A. 2001. Fan Loyalty in Professional Sports: An Extension to the National Football League. *Journal of Sports Economics*. 2: 275-284.

Eddy, T., D. Raxcher and R. Stewart. 2016. Where is Everyone? An Examination of Attendance at College Football Bowl Games. *International Journal of Sports Finance*. 11: 26-45.

Falls, G.A. and P.A. Natke. 2014. College Football Attendance: A Panel Study of the Football Bowl Subdivision. *Applied Economics*. 46 (Issue 10): 1093-1107.

Groza, M.D. 2010. NCAA Conference Realignment and Football Game Day Attendance. *Managerial and Decision Economics*. 31: 517-529.

Huang, K and M.A. Dixon. 2013. Examining the Financial Impact of Alcohol Sales on Football Game Days: A Case Study of a Major Football Program. *Journal of Sports Management*. 27: 207-216.

Humphreys, B. R. 2006. The Relationship between Big-Time College Football and State Appropriations for Higher Education. *International Journal of Sport Finance*, 1: 119-128.

Krautmann, A.C. and D.J. Berri. 2007. Can We Find It at the Concessions? Understanding Price Elasticity in Professional Sports. *Journal of Sports Economics*. 8: 183-191.

Lentz, B.F. and D.N. Laband. 2009. The Impact of Intercollegiate Athletics on Employment in the Restaurant and Accommodations Industries. *Journal of Sports Economics*. 10: 351-368.

Leonard, James M. 2005. The Geography of Visitor Attendance at College Football Games. *Journal of Sport Behavior*. 28: 231-255.

Martinez, J.M.; J.L. Stinson, K. Minsoo, and C.B. Jubenville. 2010. Intercollegiate Athletics and Institutional Fundraising: A Meta-Analysis. *Sport Marketing Quarterly*. 19: 36-47.

Noll, Roger G. 2011. Endogeneity in Attendance Demand Models. Stanford Institute for Economic Policy Research, Discussion Paper No. 11-013.

Paul, R.; B.R. Humphreys and A. Weinbach. 2012. Uncertainty of Outcome and Attendance in College Football: Evidence from Four Conferences. *Economic and Labour Relations Review*. 23: 69-81.

Perez, S.J. 2012.Does Intercollegiate Athletics Draw Local Students to a University? *Journal of Sports Economics*. 13: 198-206.

Price, D. and K. Sen. 2003. The Demand for Game Day Attendance in College Football: An Analysis of the 1997 Division I-A Season. *Managerial and Decision Economics*. 24: 35-46.

Stinson, J.L.; A. Marquardt and J. Chandley. 2012. An Empirical Examination of University Intercollegiate Athletic Expenditures. *Sport Marketing Quarterly*. 21: 104-114.

Tucker, I.B. 2005. Big-Time Pigskin Success: Is there an Advertising Effect? *Journal of Sports Economics*. 6: 222-229.

Welki, A.M. and T.J. Zlatoper. 1994. U.S. Professional Football: The Demand for Game-Day Attendance in 1991. *Managerial and Decision Economics*. 15: 489-495.

Welki, A.M. and T.J. Zlatoper. 1999. U.S. Professional Football Game-Day Attendance. *Atlantic Economic Journal*. 27: 285-298