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Econometrics 303

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Analyzing Admission to Amusements Attendance: Using Economic Indicators and Forecasting Methods

Introduction

This analysis aims to evaluate trends in admission to amusement and overall economic factors which influence the attendance. There must be a reason for how individuals' budget for these events. Event and project managers have to act creativity when they are faced with economic side effects of the market. They may set aside some money to attend or utilize what is left over in their disposable income to pay for it. This also indicates how much they are willing to pay for a ticket. Several predictable factors, such as recessions, but unpredictable factors, such as global pandemics. In the following sections, a time series analysis and regression will be performed on the admission to amusement data. The second section is an overview of the measure of central tendencies and a line graph of Admission to amusements. The fourth section of the paper describes how each test was conducted.

Theoretical Model

Firstly, this data aims to forecast the changes in real personal consumption expenditures of admission over thirty-six years. Live entertainment excludes sports but includes theaters, music festivals, theme parks, art exhibitions, operas, musicals, dance performances, and holiday celebrations. The second part of the theoretical model will examine what economic factors influence attendance.

The forecasting data will be yearly, utilizing the Observation DATE variable. This information starts every year (1/1/2089) as an example. For the theoretical model, admission to

amusements will be the dependent variable, and the rest of the variables are independent. All the data was annualized and collected from the Federal Reserve of Economic Data (FRED. et al.).

Before creating any type of regression, it is good economic practice to hypothesize what the independent variable signs could be. The `ProducerPriceIndex`, for instance, would most likely be negative as it is an indication of inflation and it could affect ticket price sales. This can also indicate how much labor musical artists, indication of inflationary pressures (raw material, labor, energy). The second variable is `HealthInsurance2534`. This variable could also be positive or negative as consumers could choose to prioritize their health insurance over amusements or those with health insurance will also be able to afford. The third variable is `HoursworkedbyFullandPartime`. Those with fulltime availability may have more money to pay for amusement, but they may have less time to attend amusements.

The fourth, fifth, and sixth variables are related to children under 18 in the Midwest (`ChildrenUnder18MW`), South (`ChildrenUnder18S`), and North East (`ChildrenUnder18NE`). All of these variables are positive because any individual going to these events would increase the overall revenue. The seventh variable is an unemployment rate of those in the age group of 15 to 64. (`Unemployment Rate 1564`). Similar to health insurance, this could be positive or negative because these individuals could have more or less time to spend on amusement. Additionally, they could have less money to spend.

`AllemployeesartsRecThousands` is the number of all employees in the arts and recreation. This would be a positive sign as attendance would drive the need for employees to run activities. `Employmentrate55to64` Those in the retirement age range could also spend more on these types of activities or focus more on other activities. Lastly, `RealDisposableIncome` would most likely be positive as the more money individuals have, the more they can spend on amusements.

The Data

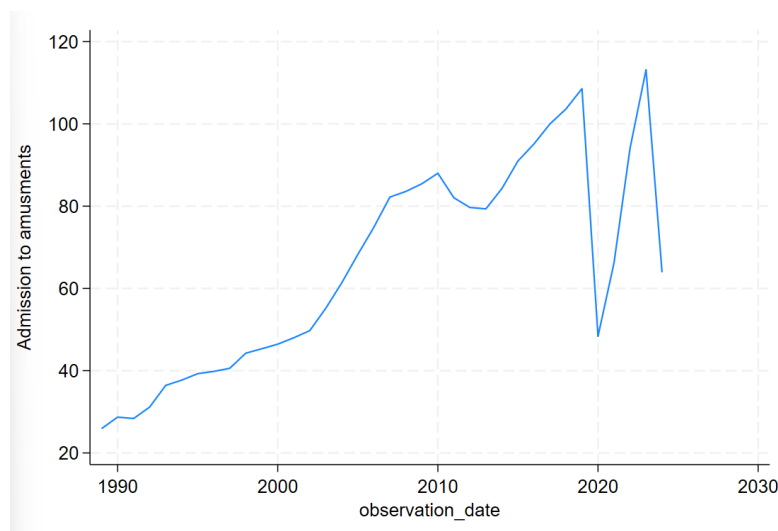
The inquiry will be a time series analysis of personal consumption expenditures on admission to gauge admission status. The second analysis will be a regression to analyze what economic factors affect attendance. Admission to amusements inclined until 2010 and steadily

declined during 2012. It increased steadily again until 2020 but sharply decreased due to COVID-19 lockdown procedures. The producer price index, over this 36-year time period, has an average of 165.1109 and a standard deviation of 41.40%. The average disposable income over this period of time is \$38542.51. The minimum is \$28,613, and the maximum is \$51,567.25.

The minimum admission fee to amusement is \$25.92, and the maximum is \$113.174. Over the past 36 years, the overall cost of maintaining a lifestyle has grown. Activities have gotten more expensive; however, this has not impeded individuals' willingness to pay for them.

Variable	Obs	Mean	Std. dev.	Min	Max
observation	36	2006.5	10.53565	1989	2024
ProducerPr~x	36	165.1109	41.40719	112.2417	264.481
Hourswork~e	36	226705.4	18411.85	192286	259928
Admissiont~s	36	65.2783	25.63147	25.923	113.174
HealthI~2534	36	1126.5	668.9833	320	2412
MedianFami~e	36	57777.65	15950.29	34210	92750
RealDispos~e	36	38542.51	6631	28613.83	51567.25
ChildrenUn~W	36	.6352941	.0528197	.5	.7
Children~18S	36	.6411765	.0540774	.5	.7
ChildrenUn~E	36	.5764706	.0537658	.5	.7
Unemplo~1564	36	5.821027	1.615379	3.696233	9.768028
Allemploye~n	36	1831.357	367.9875	1133.142	2518.925
Employmen~64	36	59.27311	3.232628	53.23657	64.16041

Below is a graph personal consumption expenditure of amusement admission vs years.



There are some strengths and weaknesses to remember when creating any data set. There is not a whole year accounted for 1/1/2024, so admission to amusements/real pictures of

amusements declines. The real expenditures of amusement are a collective of live music, opera, ballet, and much more. This makes the dataset category vast, so the sights gathered may not be effective for each amusement. Nonetheless, there are definite strengths when working with both types of models. Identifying some influencing factors for event planners, such as target marketing, to make a data-driven decision to optimize attendance at a given amusement.

Empirical Model.

First, a time series prediction will be applied. The admission to amusement variable is measured in real personal consumption expenditures in USD. All children under 18 in the East, Midwest, and South were measured in several individuals. Additionally, Employment for arts, entertainment, and recreation is measured in thousands of jobs. The producer price index is an economic indicator, so it is just a metric that provides insight into how domestic prices have changed over time. Hours worked by full-time and part-time employees units are several hours worked. The employment rate from 55-64 years and the unemployment rate from 15-64 years are measured in population percentage. Median family income was measured in current dollars, and real disposable income was measured in chained 2017 dollars. Chained dollars are a way to adjust real dollars for inflation over time.

No functional form transformations were applied to the first or second regression. Each of these variables has a data point for the years 1989-2024; therefore, the regression data has 36 data points.

Empirical results

In order to conduct a time series data test, an initial dickey-fuller test was conducted on Admissiontoamusement. The p-value was 0.0843, so the data was not stationary. Then, the first different dickey fuller test with a p value of 0.000 indicates that the data is stationary. Moreover, Finding the autoregressive coefficient. The graph indicates that it can be around 1-2. Both (1,1,1) and (2,1,1) were tested.

2. dfuller d.Admissiontoamusments, trend regress

Dickey-Fuller test for unit root Number of obs = 34
Variable: D.Admissiontoamusments Number of lags = 0

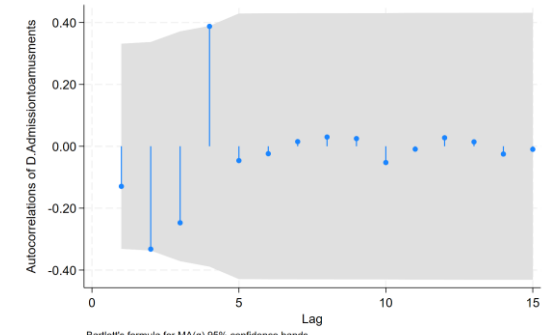
H0: Random walk with or without drift

Test statistic	Dickey-Fuller critical value		
	1%	5%	10%
Z(t)	-5.531	-4.297	-3.564
			-3.218

Mackinnon approximate p-value for Z(t) = 0.0000.

Regression table

D2. Admissiontoamusments	Coefficient	Std. err.	t	P> t	[95% conf. interval]
Admissiontoamusments					
LD.	-1.186589	.2145182	-5.53	0.000	-1.624101 - .7490759
_trend	-.2064421	.274116	-0.75	0.457	-.7655054 .3526212
_cons	5.126793	5.50914	0.93	0.359	-6.109173 16.36276



The AIC value on Arima model (2,1,1) was lower than Arima model (1,1,1). So this model was utilized for forecasting purposes. After solidifying this model, nine time periods prior to 2024, of the in real personal consumption expenditures of admission, were able to be predicted.

ARIMA regression

Sample: 1990 thru 2024 Number of obs = 35
Wald chi2(2) = 2.51
Log likelihood = -140.8626 Prob > chi2 = 0.2855

D. Admissiontoamusments	Coefficient	OPG std. err.	z	P> z	[95% conf. interval]
Admissiontoamusments					
_cons	1.933964	.5392385	3.59	0.000	.877076 2.990852
ARMA					
ar					
L1.	.4310616	.2779818	1.55	0.121	-.1137728 .975896
ma					
L1.	-.9999973	2030.484	-0.00	1.000	-3980.675 3978.675
/sigma	13.0224	13221.24	0.00	0.500	0 25926.17

Note: The test of the variance against zero is one sided, and the two-sided confidence interval is truncated at zero.

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Akaike's information criterion and Bayesian information criterion

Model	N	ll(null)	ll(model)	df	AIC	BIC
.	35	-.140.8626		4	289.7253	295.9466

Note: BIC uses N = number of observations. See [R] IC note.

ARIMA regression

Sample: 1990 thru 2024 Number of obs = 35
Wald chi2(3) = 9.77
Log likelihood = -138.8596 Prob > chi2 = 0.0206

D. Admissiontoamusments	Coefficient	OPG std. err.	z	P> z	[95% conf. interval]
Admissiontoamusments					
_cons	1.589407	3.173238	0.50	0.616	-4.630024 7.808839
ARMA					
ar					
L1.	.1649134	.5847359	0.28	0.778	-.9811478 1.310975
L2.	-.4789282	.6457898	-0.74	0.458	-1.744653 .7867966
ma					
L1.	-.5057431	.6405666	-0.79	0.430	-1.761231 .7497444
/sigma	12.62371	1.480157	8.53	0.000	9.722653 15.52476

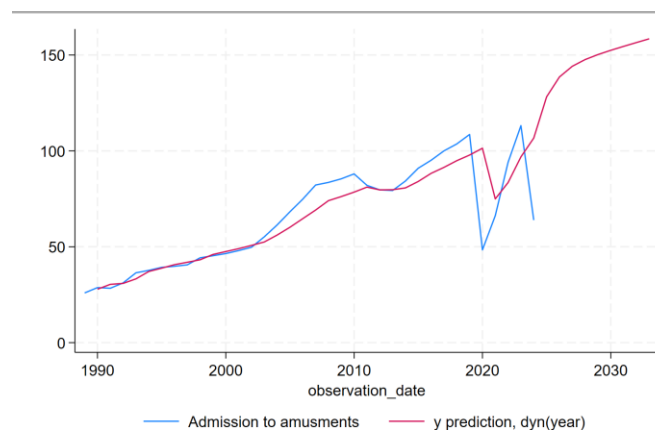
Note: The test of the variance against zero is one sided, and the two-sided confidence interval is truncated at zero.

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Akaike's information criterion and Bayesian information criterion

Model	N	ll(null)	ll(model)	df	AIC	BIC
.	35	-.138.8596		5	287.7191	295.4959

Note: BIC uses N = number of observations. See [R] IC note.



Regardless of the pandemic in 2020, admissions appear to increase steadily until 2033. Furthermore, a regression was conducted to see what types of economic factors influence amusement attendance.

```
. summarize observation_date Admissiontoamusments fAdmissiontoamusments
```

Variable	Obs	Mean	Std. dev.	Min	Max
observation_date	45	2011	13.13393	1989	2033
Admissiontoamusments	36	65.2783	25.63147	25.923	113.174
fAdmissiontoamusments	44	82.28516	39.77098	27.85696	158.464

Additionally, activities such as amusements, will only become more expensive in the next nine years. The high being \$158.464 dollars.

Source	SS	df	MS	Number of obs	=	36
Model	22457.2903	12	1871.44086	F(12, 23)	=	80.19
Residual	536.743722	23	23.3366836	Prob > F	=	0.0000
Total	22994.034	35	656.972401	R-squared	=	0.9767
				Adj R-squared	=	0.9645
				Root MSE	=	4.8308

Admissiontoamusments	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
observation_date	-.1963227	.2639106	-0.74	0.464	-.7422634	.3496179
ProducerPriceIndex	.1022794	.071508	1.43	0.166	-.0456463	.250205
hoursworkedbyFullandParttime	-.0015533	.0003325	-4.67	0.000	-.0022412	-.0008654
HealthInsurance2534	.0114042	.0065586	1.74	0.095	-.0021632	.0249717
MedianFamilyIncome	.0012412	.000489	2.54	0.018	.0002296	.0022528
RealDisposableIncome	-.003275	.0006781	-4.83	0.000	-.0046776	-.0018723
ChildrenUnder18MW	3.459856	38.39712	0.09	0.929	-75.97063	82.89034
ChildrenUnder18S	71.18173	31.43134	2.26	0.033	6.161053	136.2024
ChildrenUnder18NE	-2.449462	27.05234	-0.09	0.929	-58.41149	53.51256
UnemploymentRate1564	.8843095	.7857846	1.13	0.272	-.7412098	2.508929
AllemployeesartsRecThousan	.0717571	.0115482	6.21	0.000	.0478678	.0956464
Employmentrate55to64	7.012422	1.766573	3.97	0.001	3.357986	10.66686
_cons	237.4793	522.066	0.45	0.653	-842.4964	1317.455

Secondly, a linear regression was conducted to observe what economic factors affect the real consumption expenditures on amusements. The negative values are observation date, hours worked by full and part-time individuals, real disposable income, and children under 18 NE. The rest of the variables had positive t values. The model was able to capture 96.4% of the variance. The Ramsey reset test produced an F score of 9.35 and a p-value score of 0.0005. The p value for during the Ramsey reset can be an indication of incorrect functional form or missing variables.

The Breush-Pagen metric produced a value of 0.662, which is higher than the level of significance of 0.05. Therefore, the model does not indicate heteroscedasticity.

. vif	
Ramsey RESET test for omitted variables Omitted: Powers of fitted values of Admissiontoamusments	
H0: Model has no omitted variables	
F(3, 20) = 9.35 Prob > F = 0.0005	
. estat hettest	
Breusch-Pagan/Cook-Weisberg test for heteroskedasticity Assumption: Normal error terms Variable: Fitted values of Admissiontoamusments	
H0: Constant variance	
chi2(1) = 0.19 Prob > chi2 = 0.6622	
Variable	VIF
MedianFami~e	91.25
Hourswork~e	56.22
Employment~64	48.91
RealDispos~e	30.32
HealthI~2534	28.87
Allempleye~n	27.08
ProducerPr~x	13.15
observatio~e	11.59
ChildrenUn~W	6.17
Children~18S	4.33
Children~18E	3.17
Unemplo~1564	2.42
Mean VIF	26.96
1/VIF	
MedianFami~e	0.010959
Hourswork~e	0.017786
Employment~64	0.020445
RealDispos~e	0.032981
HealthI~2534	0.034636
Allempleye~n	0.036921
ProducerPr~x	0.076052
observatio~e	0.086245
ChildrenUn~W	0.162100
Children~18S	0.230788
Children~18E	0.315174
Unemplo~1564	0.413823

The top three variance-induced factor variables are median family income, Hours worked by full- and part-time employees, and employment of individuals ages 55-64.

A second linear regression was conducted upon further analysis, excluding the negative-t values and the top three values from the variance inflation factors. This model, while capturing only 91.1% of the variance, demonstrated strong performance in other tests.

Source	SS	df	MS	Number of obs	=	36
Model	21308.6602	6	3551.44336	F(6, 29)	=	61.11
Residual	1685.37386	29	58.1163398	Prob > F	=	0.0000
				R-squared	=	0.9267
				Adj R-squared	=	0.9115
Total	22994.034	35	656.972401	Root MSE	=	7.6234

Admissiontoamusments	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
ProducerPriceIndex	.1157016	.0740333	1.56	0.129	-.0357135	.2671167
HealthInsurance2534	-.0037994	.0036621	-1.04	0.308	-.0112893	.0036905
ChildrenUnder18MW	-23.08105	48.93566	-0.47	0.641	-123.1657	77.00361
ChildrenUnder18S	35.85194	47.59452	0.75	0.457	-61.48979	133.1937
UnemploymentRate1564	2.440844	1.007722	2.42	0.022	.379821	4.501866
AllempleyesartsRecThousan	.0644023	.0081547	7.90	0.000	.047724	.0810805
_cons	-90.0212	47.533	-1.89	0.068	-187.2371	7.194707

The second model had a higher F value, of 18.89, but had a p value of 0.000. This could mean a model specification error or a missing variable. The Breush-Pagan test had a value of 0.7470 which is higher than the significance level of 0.05. Therefore, the hypothesis of heteroskedastic was rejected in this model as well. Moreover, all the variables had reactively low variance inflation factors.

```

ovtest

Ramsey RESET test for omitted variables
Omitted: Powers of fitted values of Admissiontoamusements

H0: Model has no omitted variables

F(3, 26) = 18.69
Prob > F = 0.0000

estat hettest

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of Admissiontoamusements

H0: Constant variance

chi2(1) = 0.10
Prob > chi2 = 0.7470

```

```

. vif

```

Variable	VIF	1/VIF
producerPr~x	5.66	0.176695
llemploye~n	5.42	0.184394
hildrenUn~W	4.02	0.248535
hildren~18S	3.99	0.250659
healthI~2534	3.61	0.276652
lneemplo~1564	1.60	0.626614
Mean VIF	4.05	

Conclusions

Overall, both models could describe the general trends of amusements and what economic factors play. In general, both the time series data and the linear regression make logical sense. The inflation over the last 36 years has caused ticket prices to increase. Moreover, removing variables did not increase the model variation or the misspecification issues. Attempting different transformations, such as double log, could help produce better metrics.

There are ecological and demographic factors that should be considered. Some ideas are natural disasters, which cause project managers to demand the amusement of something else. This may cause them to fall short of the revue projection or unexpectedly find a new creative idea. Additionally, reducing the scope of the amusement variable may cater to specialized solutions. As mentioned, the admission to amusement variable focused on several types of activities besides sporting activities. They are gathering data on one type of amusement. This could be gathering information from one artist, one type of amusement such as live music, or outdoor events.

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