

THE INCREASE IN OHIO LOTTERY PICK 3 AND PICK 4 SALES FROM INTRODUCING MIDDAY DRAWINGS

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INTRODUCTION

STATE LOTTERIES HAVE BECOME A SIGNIFICANT source of state revenue. The 42 state lotteries, along with the District of Columbia lottery and the Puerto Rico lottery, generated \$17 billion in profits from the sale of \$57 billion of lottery games in fiscal year 2006.¹ This 30 percent average profit margin for lotteries is used to fund public expenditures.

Many American lotteries have had difficulty maintaining the same level of revenue over time with the same lottery products and jackpots, as players become bored with “the same old game.” In addition, state lotteries face increasing competition as legalized casino gaming expands in the form of Indian casino gaming, riverboat casinos, racinos, etc. Lottery administrators continually adjust the mix of games and the features of games in order to maintain interest in lottery play.

After the election of a new governor in 1998, the Ohio Lottery introduced new lottery products to “increase revenues through product research, design, development, and support.”² In an attempt to reverse declining sales, the Ohio Lottery added midday drawings for the Pick 3 and Pick 4 games on August 16, 1999. Many states have introduced midday lottery drawings in an effort to boost lottery sales and state lottery profits. Twenty-three lotteries offer midday Pick 3 drawings.³ Twenty-one lotteries offer midday Pick 4 drawings.⁴ On two separate occasions in 1999 and 2000, the Ohio Lottery also ran Red Ball promotions that featured better players’ odds for the Pick 3 game. Despite the introduction in multiple states of midday and Red Ball drawings for daily lottery games, there has been no economic evaluation of these drawings in stimulating lottery sales and profits.

This paper uses a panel of monthly lottery sales and demographic variables for 831 zip codes from January 1998 to December 2000 to examine the changes in sales of the Pick 3 game per adult and the Pick 4 game per adult. We estimate the average percentage gain in Ohio Lottery Pick 3 and Pick 4 sales caused by the introduction of the midday and Red Ball drawings.

AN INTRODUCTION TO THE OHIO LOTTERY

Ohio is one of 42 states with a state lottery. The Ohio Lottery transfers 100 percent of its profits, \$696.3 million from \$2.26 billion in sales in fiscal year 2007, to education.⁵ The Ohio lottery has struggled to maintain sales in the face of lottery fatigue and increasing competition from casinos in Indiana, Michigan, and West Virginia. When introducing midday drawings for the Pick 3 and Pick 4 games in 1999, Ohio Lottery Commission Chairman Sandra K. Barber said, “We’re a mature lottery, and we have to continue to come up with new ideas.”⁶ Table 1 shows that total Ohio Lottery sales peaked at \$2.31 billion in 1996.

The Ohio Lottery offers a variety of lottery products as shown in Table 1. Included in the array of products are numbers games (i.e., Pick 3 games and Pick 4 games). Pick 3 games offer players the opportunity to choose three numbers. If a player picks all three drawing numbers in order, a one dollar straight bet, the player wins \$500. This standard Pick 3 bet has 1 in 1000 odds, yielding an expected return of 50 cents for every dollar bet. There are also a variety of boxed bets in which a player wins if the three numbers from the drawing match the player’s numbers in any order. Each of these Pick 3 bets has an expected return of 50 cents on a dollar bet. This expected return is quite low compared to bets in casino games. Pick 4 games offer players the opportunity to choose four numbers. If a player picks all four drawing numbers in order, a one dollar straight bet, the player wins \$5,000.⁷ This standard straight Pick 4 bet has 1 in 10,000 odds, yielding an expected return of 50 cents for every dollar bet. Other Pick 4 bets also have an expected return of 50 cents for every dollar bet.

Pick 3 sales in Ohio peaked in 1996 at \$450.6 million. Table 1 and Figure 1 show that Pick 3 sales rebounded in fiscal 2000 (July 1999 to June 2000), after the Pick 3 midday drawings began in August 1999, but have continued to decline in recent years. Table 2 shows Pick 3 sales as a percentage of total Ohio Lottery sales. Pick 3 was a declining share of lottery sales before the midday drawings began in August 1999. There was a slight rebound in Pick

Table 1
Ohio Lottery Sales 1990-2007
(in millions)

Year	Pick 3	Pick 4	Buckeye 5/Rolling Cash 5	Super Lotto Plus/Lot O Play	Kicker	Mega Millions	Cards	Total Online Games	Instant Games	Total Lottery Sales
1990	414.2	77.4		530.8	84.6			1107.0	513.9	1620.9
1991	411.7	79.1		451.4	71.3		24.7	1038.2	526.3	1664.2
1992	411.1	85.4	25.7	500.0	69.5		9.5	1101.2	584.2	1685.4
1993	428.3	91.0	122.4	493.5	65.6			1200.8	775.7	2117.2
1994	421.0	91.9	118.2	370.6	54.3			1149.7	1032.6	2182.3
1995	446.2	102.1	100.3	437.8	63.3			1149.7	1032.6	2182.3
1996	450.6	108.2	87.3	455.8	66.7			1168.6	1146.1	2314.7
1997	435.6	116.5	78.8	410.6	63.5			1105.0	1195.0	2300.0
1998	421.1	124.0	73.8	384.9	60.5			1064.0	1131.8	2195.8
1999	399.4	125.1	69.9	364.4	57.2			1016.0	1128.7	2144.7
2000	427.3	144.6	62.2	336.6	52.9			1023.6	1126.8	2150.4
2001	419.0	150.7	56.5	262.5	42.9			931.6	988.3	1919.9
2002	409.2	154.6	62.4	297.9	45.0	16.5		985.6	997.5	1983.1
2003	401.8	154.2	68.9	160.7	27.3	176.2		989.1	1089.1	2078.3
2004	396.8	165.2	66.6	143.8	24.5	191.8		988.7	1166.0	2154.7
2005	387.7	170.1	74.8	113.0	19.9	176.4		941.9	1217.2	2159.1
2006	377.3	175.7	72.6	76.3	21.6	223.4		946.9	1274.0	2220.9
2007	370.9	183.0	72.9	21.8	21.3	196.1		905.6	1353.8	2259.4

Source: The Ohio Lottery Commission (various years).

Figure 1: Ohio Lottery Pick 3 and Pick 4 Yearly Sales, 1990 – 2007

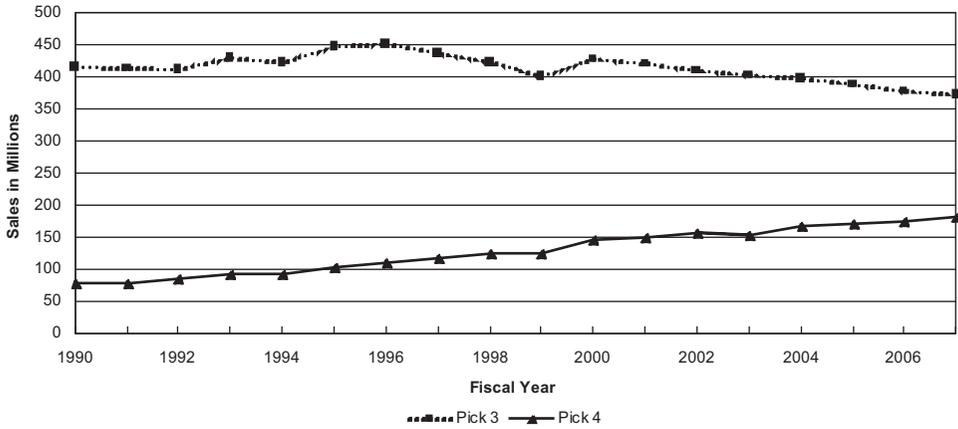


Table 2
**Pick 3 and Pick 4 Sales as a % of Total Lottery Sales,
 1990-2007**

<i>Fiscal Year</i>	<i>Pick 3 Sales as a % of Total Lottery Sales</i>	<i>Pick 4 Sales as a % of Total Lottery Sales</i>
1990	25.60%	4.80%
1991	24.70%	4.80%
1992	24.40%	5.10%
1993	20.20%	4.30%
1994	19.30%	4.20%
1995	20.40%	4.70%
1996	19.50%	4.70%
1997	18.90%	5.10%
1998	19.20%	5.60%
1999	18.60%	5.80%
2000	19.90%	6.70%
2001	21.80%	7.80%
2002	20.60%	7.80%
2003	19.30%	7.40%
2004	18.40%	7.70%
2005	18.00%	7.90%
2006	17.00%	7.90%
2007	16.42%	8.10%

Source: The Ohio Lottery Commission (various years).

3 sales as a percentage of total sales after the midday drawings began, but then Pick 3 continued to decline as a share of all lottery sales.

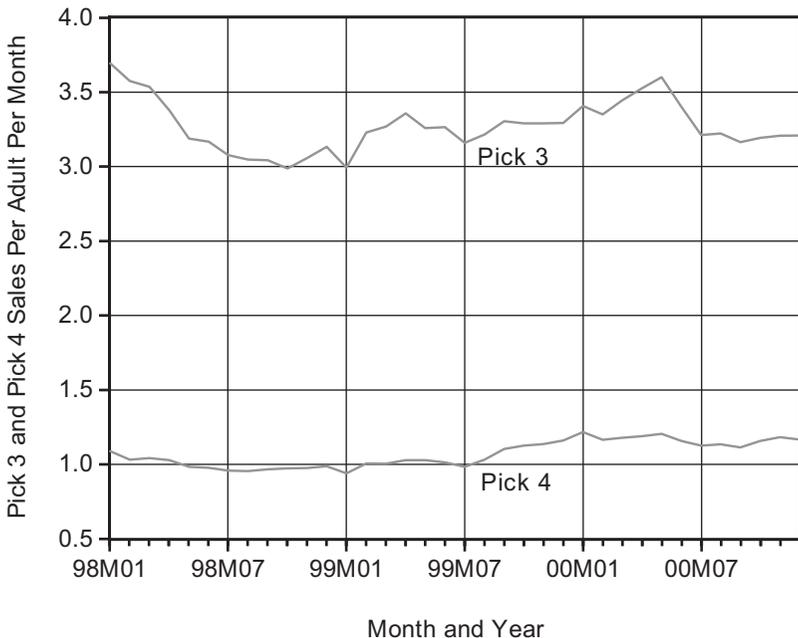
The Pick 4 games have trailed Pick 3 games in sales volume. After stagnant sales from fiscal year 1998 to 1999, Pick 4 sales increased by \$19.5 million in fiscal year 2000 after the introduction of Pick 4 midday drawings in 1999. In contrast to the Pick 3 game, Pick 4 sales have steadily grown in recent years. In 2007, the Ohio Pick 4 games had record sales of \$183 million. Pick 4 sales as a share of total lottery sales have also increased over time. As shown in Table 2, Pick 4 sales jumped from 5.8 percent of total Ohio Lottery sales in fiscal year 1999 to 7.8 percent of total sales in fiscal year 2001, the second fiscal year with midday drawings for the Pick 4 game. The Ohio Lottery pays approximately 6.28 percent of Pick 3 and Pick 4 sales to lottery retailers as commission and bonuses for selling winning lottery tickets.⁸

On Aug. 16, 1999, Ohio launched midday drawings for Pick 3 and Pick 4 numbers games. The midday drawing, held at 12:29 p.m., is an addition

to the traditional 7:29 p.m. drawing. By adding the midday drawing, the lottery doubled the number of weekly drawings from 6 to 12. The Ohio Lottery did not hold Sunday drawings until May 20, 2007. The midday drawings permit players to place bets for the Pick 3 and Pick 4 games anytime after 7:30 p.m. and receive the resolution of the bet by 12:29 p.m. instead of waiting until 7:29 p.m. the following day. This more exciting and rapid play could be viewed as an attempt to compete with the instant excitement and resolution of a bet associated with casino gambling. Midday drawings also allow lottery players to play twice a day instead of just once a day. Players can actually place a bet on a drawing several days in advance. However, if gamblers crave or seek excitement, having more opportunities to place a bet may offer more opportunities for excitement.

The sales of numbers games show seasonal variation and other variation over time. Figure 2 shows a plot of sales of Pick 3 and Pick 4 games per adult per month (averaged across observations) from January 1998 through December 2000. Pick 3 sales in the last six months of the sample period

Figure 2: **Average Pick 3 sales per adult per month and Pick 4 sales per adult per month (in dollars)**
Monthly data January 1998 - December 2000



for each game appear to be well above the lows of the first half of the sample.

In another effort to boost sagging Pick 3 sales, the Ohio Lottery ran Red Ball promotions in June and July 1999 and April and May 2000. The Red Ball promotion increases the payouts to winning tickets in the Pick 3 game by approximately 20 percent when a red ball is drawn from a tumbler. When a red ball is drawn, then a straight Pick 3 bet pays \$599 instead of \$500.⁹ The goal of the Red Ball promotion is to increase the volume of Pick 3 bets by enough to increase total revenue and profits from the Pick 3 despite the better odds for players.

During the first Red Ball promotion in June and July 1999, there were initially 10 balls (9 white balls and 1 red ball) in the separate tumbler. When a white ball was drawn it was removed from the tumbler for the next Red Ball drawing. After a Red Ball was drawn, all 10 balls were reloaded into the tumbler. A Red Ball was expected to be drawn about once in every 5.5 drawings. This Red Ball promotion changes the expected payout of a dollar bet from 50 cents to between 50.99 cents and 59.99 cents depending on the number of balls in the tumbler based on recent Red Ball drawings. On average the ex ante expected payoff is 51.80 cents.

The second Red Ball promotion in April and May 2000 was set up like the first except that initially only seven balls (six white balls and one red ball) were placed in the separate tumbler. With this modification in the odds, a Red Ball was expected to be drawn about once in every 4 drawings. This Red Ball promotion changes the expected payout of a dollar bet from 50 cents to between 51.41 cents and 59.99 cents depending on the number of balls in the tumbler based on recent Red Ball drawings. On average the ex ante expected payoff is 52.48 cents.

DATA

We construct a panel of Ohio lottery data, demographic variables, and distance to casinos. The Ohio Lottery provided 36 months of Ohio Lottery sales data for 831 residential zip codes with positive sales each month from January 1998 through December 2000, for a total of 29,916 zip-code-month observations. The Ohio Lottery also provided data about the size of the Ohio Super Lotto weekly jackpots for the 36-month time period. A cross section of population data for each residential zip code is included from the *Sourcebook of Zip Code Demographics 1999*. The distance from each zip code to the nearest casino was calculated using the software included with the *Sourcebook of Zip Code Demographics 1999*.

We use only zip codes classified as residential by the *Sourcebook of Zip Code Demographics 1999* in our analysis because we should not attribute sales in a nonresidential zip code, such as an airport or major employer, to the few individuals that are reported to be residing in a nonresidential zip code. Adult population data by zip code from *Sourcebook of Zip Code Demographics 1999* was used to compute the dependent variables, Pick 3 sales per 30-day month per adult and Pick 4 sales per 30-day month per adult.

Table 3 reports descriptive statistics for each variable. Pick 3 sales, the more popular of the two numbers games, has average sales of \$3.27 per adult per month. Pick 4 sales averaged \$1.06 per adult per month. There is tremendous variation and skewness in Pick 3 and Pick 4 sales per adult across zip codes.

In order to investigate the effect of the midday drawing on Pick 3 and Pick 4 sales, we created two dummy variables related to the midday drawing, which was introduced on August 16, 1999. We cre-

Table 3
Descriptive Statistics

<i>Variable</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Minimum</i>	<i>Maximum</i>
Pick3 sales per adult per month (\$)	3.27	5.24	0.002	78.18
Pick4 sales per adult per month (\$)	1.06	1.62	0.000	33.09
Mileage to nearest casino	66.42	29.2	2.22	127.2
Super Lotto jackpot monthly average (\$mill.)	11.65	3.93	6.11	26.33
Red Ball promotion dummy	0.11	0.31	0	1
Midday drawing dummy	0.44	0.5	0	1

ated a dummy variable for the midday introductory month that equals one for August 1999 and equals zero for all other months. We also created the midday drawing dummy variable that equals one starting with the first full month during which the midday drawing was in effect (September 1999) and equals zero in prior months.

We created a dummy variable for the Pick 3 Red Ball promotion, which increased the expected value of Pick 3 winnings by increasing payouts when a Red Ball was drawn. The Red Ball promotion dummy variable equals one when the Red Ball promotion was in effect (June and July 1999 and April and May 2000) and zero if not.

Using data on weekly Super Lotto jackpots, we constructed a Super Lotto variable equal to the monthly average Super Lotto jackpot size. Relatively high Super Lotto jackpots could potentially affect sales of the Pick 3 or Pick 4 numbers games, either by attracting participation in the lottery overall or by providing a substitute to the numbers games. The mean of the Super Lotto jackpot variable is approximately \$11.6 million, with a minimum of \$6.1 million and a maximum of \$26.3 million.

Part of the impetus of the midday drawing is to improve the attractiveness of the Ohio Lottery's Pick 3 and Pick 4 games compared to the out-of-state casinos. One attractive feature of casino gambling is the excitement of a quick resolution to the bet. Some of Ohio's lottery products, such as Super Lotto, have twice-a-week drawings that provide far from a quick resolution. The Pick 3 and Pick 4 games provide a quicker resolution of the bet with daily drawings, becoming even more exciting with the twice-daily drawing innovation of August 1999. Nonetheless, casino gambling is a potential substitute for Pick 3 and Pick 4 lottery games. To capture the effects of casino proximity on Pick 3 and Pick 4 sales, we computed the distance from each zip code to the nearest of the six casinos that were operating in bordering states. Ohioans on average are located about 66 miles from the nearest casino, with a minimum distance of 2 miles (near Wheeling, West Virginia) and a maximum distance of 127 miles from the nearest casino.

THE EFFECTS OF MIDDAY DRAWINGS AND THE RED BALL PROMOTION ON LOTTERY SALES

To measure the impact of the midday drawing and Red Ball promotions on the sales of numbers

games, we estimate the following cross-section fixed-effects regression model for Pick 3 sales per month per adult and also for Pick 4 sales per month per adult:

$$y_{it} = x'_{it}B + z'_i\alpha_i + e_{it},$$

where i indexes zip codes and t indexes months. The dependent variable for the Pick 3 regressions is the logarithm of Pick 3 sales per month per adult. Our independent variables include 11 monthly dummy variables to control for seasonality in the demand for numbers games. The model includes as independent variables a time trend variable, the Red Ball dummy variable, the midday introductory month dummy variable, and the midday dummy variable. We also interact the time trend with distance to the nearest casino and with the square of the mileage to the nearest casino. Also included is the logarithm of the monthly average of the Super Lotto jackpot. Finally, cross-sectional fixed effects are included to control for heterogeneity across zip codes. We estimate a similar regression for the logarithm of Pick 4 sales per month per adult.

Table 4 reports the results of these regressions. As expected given the cross-sectional fixed effects, the Pick 3 regression explains a great deal of the variation in the logarithm of sales of Pick 3 per day per adult, with an adjusted R-squared of 0.967.

The effect of the midday drawing is estimated to increase Pick 3 sales by 10.5 percent per month per adult on average across the zip code months in our sample. We obtain this result using Gujarati's (2003) interpretation of dummy variable coefficients in semilogarithmic regressions. During the introductory month of August 1999, the midday drawing increased Pick 3 sales by 10.2 percent on average across zip code months.

The effect of the Red Ball promotion is estimated to increase Pick 3 sales by 7.47 percent per month per adult on average, using the Gujarati semilogarithmic interpretation of the estimated coefficient. This estimate can be used to calculate an own-price elasticity of demand for Pick 3 sales of -1.82. On average, the Red Ball promotions increase the expected payout to players from 50 percent to 52.14 percent, a 4.28 percent increase in payouts to players. The price of buying a dollar's worth of expected Pick 3 game winnings falls from \$2.00 to \$1.9179 during the Red Ball Promotion, or 4.105 percent. We would urge caution in using our estimate of price elasticity since the rules of

Table 4
Regression Results for Pick 3 and Pick 4 Sales per month per adult

<i>Independent Variables</i>	<i>log(Pick 3 Sales per adult)</i>		<i>log(Pick 4 Sales per adult)</i>	
	<i>Coefficient</i>	<i>t-Statistic</i>	<i>Coefficient</i>	<i>t-Statistic</i>
Constant	0.4335	30.82	-0.6681	-39.96
February	0.0100	1.52	-0.0030	-0.4
March	0.0279	4.24	0.0064	0.85
April	0.0117	1.74	0.0086	1.12
May	0.0033	0.49	-0.0143	-1.82
June	-0.0046	-0.66	-0.0322	-3.94
July	-0.0259	-3.89	-0.0443	-5.58
August	-0.0351	-4.9	-0.0421	-4.86
September	-0.0373	-5.53	-0.0507	-6.49
October	-0.0455	-7.04	-0.0353	-4.63
November	-0.0464	-7.05	-0.0331	-4.25
December	-0.0524	-7.68	-0.0356	-4.44
Time	-0.0065	-11.26	-0.003	-4.53
Time*Distance to Casino	0.000065	3.7	0.000009	0.44
Time*Distance to Casino ²	-0.0000003	-2.25	-0.0000001	-0.93
Red Ball	0.072	15.18	0.0242	4.3
Midday Introductory Month	0.0971	10.99	0.067	6.48
Midday	0.0996	17.43	0.1413	21.71
Log(Super Lotto Jackpot)	0.0188	3.64	0.0031	0.51
Cross-section fixed effects	yes		yes	
R-squared	0.968		0.958	
Adjusted R-squared	0.967		0.957	
S.E. of regression	0.218		0.256	
F-statistic	1027.131		780.1896	

the Red Ball promotion result in the odds of the game fluctuating from drawing to drawing within the promotion month, yet we observe only monthly sales data.

The regression results confirm Ohio Lottery officials' concern that the Pick 3 game was in decline. Competition from new casinos near Ohio's borders was an important source of the decline. The time trend for Pick 3 sales is negative and statistically significant. The decline in Pick 3 sales over time was sharpest in zip codes nearest out-of-state casinos.

Larger Super Lotto jackpots have a modest positive effect on Pick 3 sales. The estimated elasticity of Pick 3 sales with respect to the average monthly Super Jackpot Lotto jackpot is 0.019. If the average monthly jackpot increases 100 percent, Pick 3 sales will increase by 1.9 percent.

The midday drawings give an even larger estimated boost to Pick 4 sales of 15.18 percent per adult on average across zip code months, following the Gujarati method. Pick 4 sales are estimated to rise by 6.93 percent on average across zip codes in the introductory month. The Red Ball promotion for the Pick 3 game increases Pick 4 sales by 2.45 percent. The cross-price elasticity for Pick 4 games with respect to the price of Pick 3 games is therefore negative and estimated to be 2.45/-4.105 or -0.60. Interestingly, these two numbers games are complements. Pick 4 sales are not affected by the size of the Super Lotto jackpot. Finally, the time trend for Pick 4 sales is negative and statistically significant. A major contrast between Pick 3 and Pick 4 is that Pick 4 sales do not appear to be affected over time by distance to out-of-state casinos.

CONCLUSION

The Ohio Lottery instituted midday drawings in August 1999 and Red Ball promotions to bolster sales of its struggling Pick 3 daily numbers games. Pick 3 sales were falling before the introduction of midday drawings and Red Ball promotions. This drop in Pick 3 sales was more severe in areas near casinos, many of which opened in the mid 1990s. Midday drawings increased Pick 3 sales by 10.5 percent per adult and also increased Pick 4 sales by 15.2 percent per adult.

The Red Ball promotions were successful in raising Ohio Lottery sales. Pick 3 and Pick 4 sales per adult increased by 7.5 percent and 2.5 percent, respectively, in months with a Red Ball promotion for the Pick 3 drawings. We estimate that the own-price elasticity of demand for Pick 3 games is -1.82, and the cross-price elasticity of demand between Pick 3 and Pick 4 games is -0.60.

We also plan to investigate the distributional effects of the midday drawing for numbers games in Ohio. Clotfelter (1979) and Clotfelter and Cook (1987, 1990) and others give evidence that the lottery in general and the numbers games in particular, are played proportionally more by those with lower incomes. Estimates of changes in the income elasticities of the numbers games as a result of the midday drawing would be of interest.

Notes

¹ North American Association of State and Provincial Lotteries. <http://www.naspl.org/index.cfm?fuseaction=content&PageID=3&PageCategory=3>

² http://www.ohiolottery.com/about/about_us.html

³ Other lotteries offering midday pick 3 drawings include California, Connecticut, Delaware, Georgia, Illinois, Iowa, Indiana, Kentucky, Maine, Maryland, Michigan, Missouri, New Hampshire, New Jersey, New York, Pennsylvania, South Carolina, Tennessee, Texas, Vermont, Virginia, and Washington, D.C. Source: <http://www.betslips.com/orderp3.aspx?partner=101>

⁴ Other lotteries offering midday pick 4 drawings include Connecticut, Delaware, Georgia, Illinois, Iowa, Indiana, Kentucky, Maine, Maryland, Michigan, Missouri, New Hampshire, New Jersey, New York, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, and Washington, D.C. Source: <http://www.betslips.com/orderp4.aspx?partner=101>

⁵ <http://www.ohiolottery.com/>. The state's profits are the total losses from lottery players less administrative costs and payments to retailers.

⁶ *Cleveland Plain Dealer* (1999).

⁷ Perhaps the most famous straight Pick 4 bet in Ohio Lottery history occurred in 2006, when the Pick 4 evening drawing produced the numbers 4-2-3-9, in that order, hours after the number-one-ranked Ohio State football team defeated a Michigan team ranked number two in the nation by the score of 42 to 39. Over \$2.2 million in Pick 4 prizes were paid by the Ohio Lottery on those numbers.

⁸ E-mail from Mardele Cohen, Ohio Lottery Communications. November 27, 2006.

⁹ Lottery prizes under \$600 do not have to be reported to the IRS by the Ohio Lottery.

References

- Cleveland Plain Dealer*. Lottery to Launch Lunch Games; Commission Decides to Add a Second Daily Pick 3 and Pick 4 Drawing in an Attempt to Reverse Decline in State Gambling Revenues, July 15, 1999.
- Clotfelter, Charles T.. On the Regressivity of State-Operated "Numbers" Games. *National Tax Journal* 32 (December 1979): 543-548.
- Clotfelter, Charles T. and Philip J. Cook. Implicit Taxation in Lottery Finance. *National Tax Journal* 40 (December 1987): 533-46.
- On the Economies of State Lotteries. *Journal of Economic Perspectives* 4 (Fall 1990):105-19.
- Gujarati, Damodar N. *Basic Econometrics* (4th ed.). New York: McGraw-Hill, 2003.
- The Ohio Lottery Commission. *Comprehensive Annual Financial Report for Fiscal Years ending June 30, 2007, 2006, and 2005*. Cleveland, OH: The Ohio Lottery Commission. <http://www.ohiolottery.com/>
- Sourcebook of Zip Code Demographics 1999* (13th ed). Fairfax, VA: CACI Marketing Systems, 1999.