

Gravity Models Applied to Projections for New Casinos: Techniques and Results

Presentation to the 16th International
Conference on Gambling & Risk Taking
Las Vegas, Nevada

June 9, 2016

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Overview

- Recent U.S. casino license application processes: “beauty contests”
- Projected benefits (and costs) based on projections for future performance
- Usually involve “Gravity Models”
- 80 projections / 8 lic. processes / 4 states
- Sources / Types of Markets / Methods
- Findings: Wide range of variation

Focus / Limitations . . .

- “Regional” casino markets in North America
 - “Limited” numbers of casinos
 - Customers overwhelmingly live within 2 hours
- Less applicable / less usefully applied to:
 - “Destination resort” casinos (Las Vegas)
 - Highly competitive markets with large numbers/ clusters of casinos (LV, Deadwood (SD), Tunica (MS), Colorado mining towns, etc.)

Gravity Models – Overview

- Location
- Location
- Size
- Everything Else

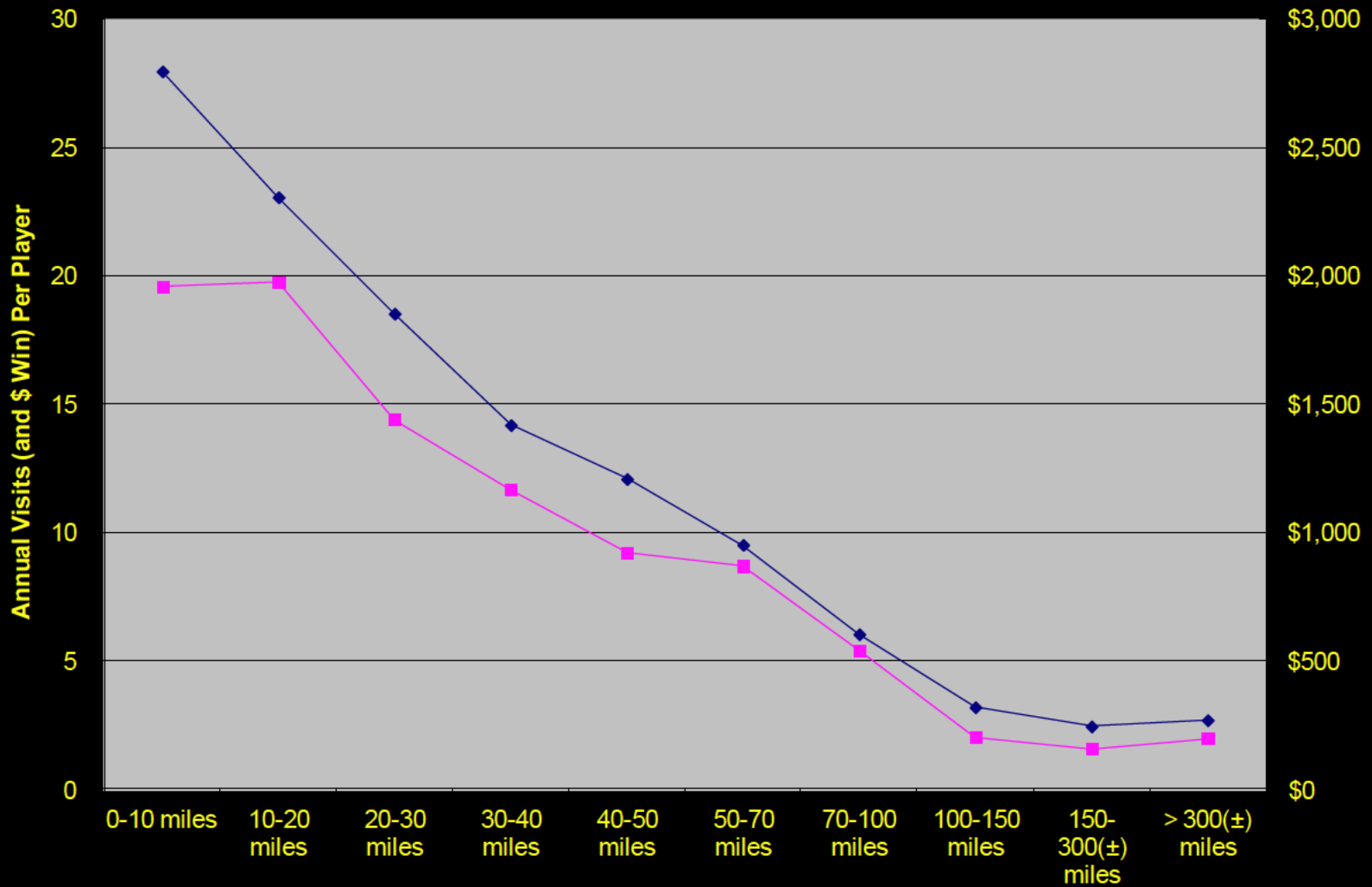
Example: SE Kansas

Gravity Models – Overview

- **Location I**
- Location II
- Size
- Everything Else

*Location I:
The Closer, the Better
=“Friction”*

Exhibit A-4: Rates of Visitation (and Win) vs. Distance at Casino Z



Gravity Models – Overview

- Location I
- Location II
- Size
- Everything Else

*Location II:
Competition*

*Location II:
Reilly's Law*

Reilly's Law:

$$ms \sim S/d^2$$

Where

ms : market share

S : outlet size (capacity)

d : distance

Newton's Law:

$$F = m/d^2$$

Where

F : gravitational force

m : mass (conjoined)

d : distance

Reilly's Law:

$$ms \sim S/d^2$$

Where

ms : market share

S : casino size (capacity)

d : distance

Reilly's Law Extended:

$$ms \sim S / tt^2$$

Where

ms : market share

S : casino size (capacity)

tt : travel time / convenience

Midwest Market Projections

Average Distances:

State	County	ZIP	Spdway	KStar	CampT	KSCr	CasR	Dodge	KC7thS	Wh CI	Horton	Mayetta	Powhat	Argosy	IOC
KS	ALLEN	66732	99	129	49	41	76	267	106	155	141	121	146	109	109
KS	ALLEN	66748	109	115	62	54	87	252	117	152	133	112	138	120	120
KS	ALLEN	66749	100	121	67	59	93	257	108	144	126	105	131	111	111
KS	ALLEN	66751	97	126	62	54	89	261	105	145	129	109	134	108	108
KS	ALLEN	66755	90	135	57	48	84	271	97	146	133	113	138	100	100
KS	ALLEN	66772	103	127	45	37	72	267	110	159	145	125	150	113	113
KS	ANDERSON	66014	66	157	68	59	95	288	73	133	121	102	126	76	76
KS	ANDERSON	66015	89	130	74	66	101	263	97	133	117	97	122	100	100
KS	ANDERSON	66032	70	147	82	73	109	277	78	121	107	87	112	82	82
KS	ANDERSON	66033	60	158	83	74	111	287	68	118	105	86	111	72	72
KS	ANDERSON	66039	78	144	66	57	93	277	86	136	123	103	128	89	89
KS	ANDERSON	66091	80	139	77	69	104	270	88	128	113	93	118	91	91
KS	ANDERSON	66093	87	130	83	75	110	261	96	129	109	88	114	99	99
KS	ATCHISON	66002	42	226	164	155	192	342	50	37	32	44	38	47	52
KS	ATCHISON	66016	44	214	164	155	191	330	53	37	27	32	33	51	56
KS	ATCHISON	66023	52	207	170	161	197	321	61	37	20	24	26	59	64
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
KS	WYANDOTTE	66106	9	216	120	110	146	338	7	86	79	65	85	10	11
KS	WYANDOTTE	66109	7	217	127	117	154	338	10	78	70	58	76	10	14
KS	WYANDOTTE	66111	7	216	122	112	148	338	7	84	76	63	82	10	11
KS	WYANDOTTE	66112	7	217	124	115	151	338	8	81	74	61	80	10	11
KS	WYANDOTTE	66118	13	223	124	115	147	346	7	88	81	69	88	7	7

Total KS

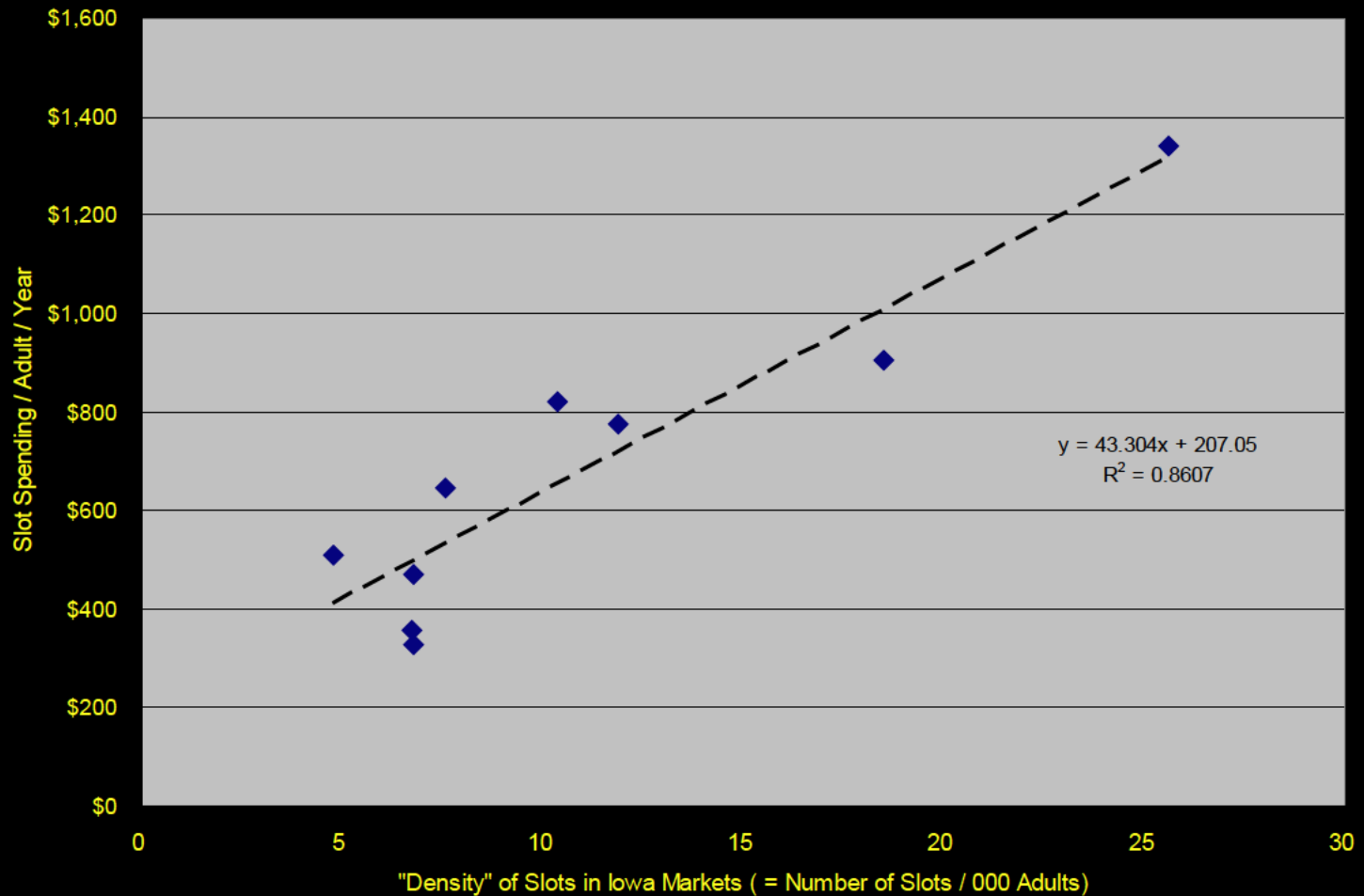
Gravity Models – Overview

- Location
- Location
- **Size**
- Everything Else

Bigger IS Better

- Consumer choice
 - Micro-environments
 - Ancillary attractions
 - Queuing issues even if not capacity-constrained
- Economies of scale
 - Ancillary attractions
 - Player rewards

More Slots, More Spending



Gravity Models – Overview

- Location
- Location
- Size
- **Everything Else**

“Everything Else” I

- Personal Income
- Micro-Access
- Spaciousness
- Game Mix
- Fit & Finish
- Management Skill
- Marketing / Player Rewards

“Everything Else” II

- Hotel
- Parking Garage
- Variety of Dining Choices
- “ / Retail
- “ / Entertainment
- “Brand”
- Tax / Retention Rate

Add-Ons to Gravity Models

- Seasonal residents
- Casino Hotel guests
- Other (nearby) hotel guests
- “Drive-By Intercept”
- Other visitors / extraordinary circumstances

Current Study

Objectives and Scope

- Preliminary Exploration
- Focus: Projections vs. Projections, not Projections vs. Actual Results
- 80 Projections* for 27 Casinos*
- Only 5 actually built (so far)
(15 projections related thereto)

* Excludes “synthetic” projections but includes “generic” casinos

Licensing Processes:

- Kansas
 - 2008, 2009, 2010, 2014
- Iowa
 - 2009, 2013-14
- Massachusetts 2013-14
 - “Slot parlor” only
- Maryland 2013

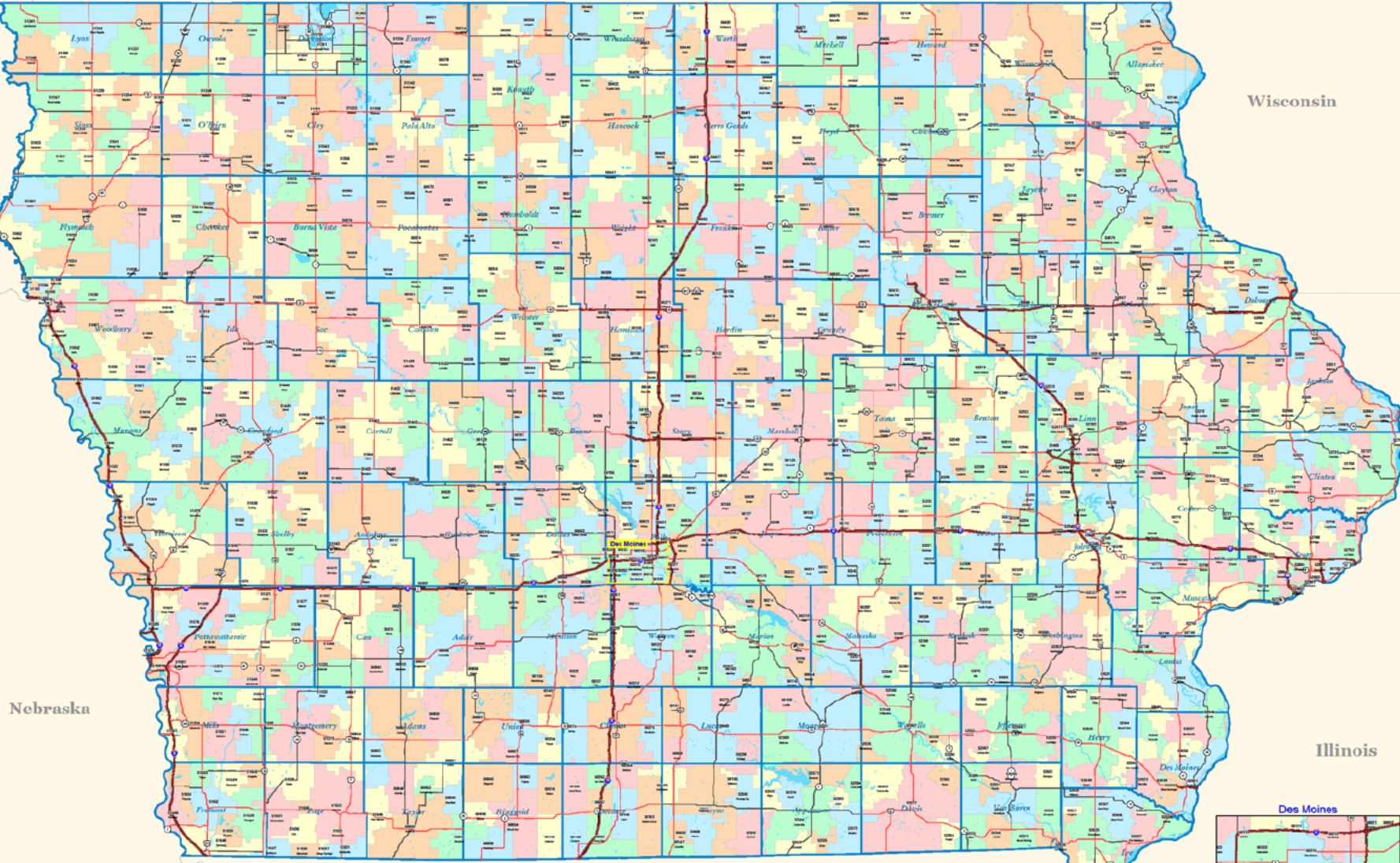
Markets / Methodologies:

- Type(s) of markets
 - Monopoly
 - Middling
 - Competitive
- Methodological approaches
 - “Fine-Grained” Aggregate Behavior
 - “Coarse-Grained” “ ”
 - “Black Box” or insufficient info

Minnesota

Wisconsin

South Dakota



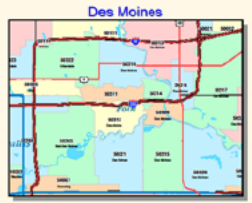
Nebraska

Illinois

Missouri

County ■ ZIP Code ■ US interstate — US Highway — State Highway —
■ e.g. Johnson ■ e.g. 47007 — e.g. I-70 — e.g. US-1 — e.g. State Route 40

Iowa ZIP Codes



Competitive Gaming Market: Iowa & Surrounding States

Note: shaded areas as a whole reflect the primary collective draw area for Iowa's commercial casinos

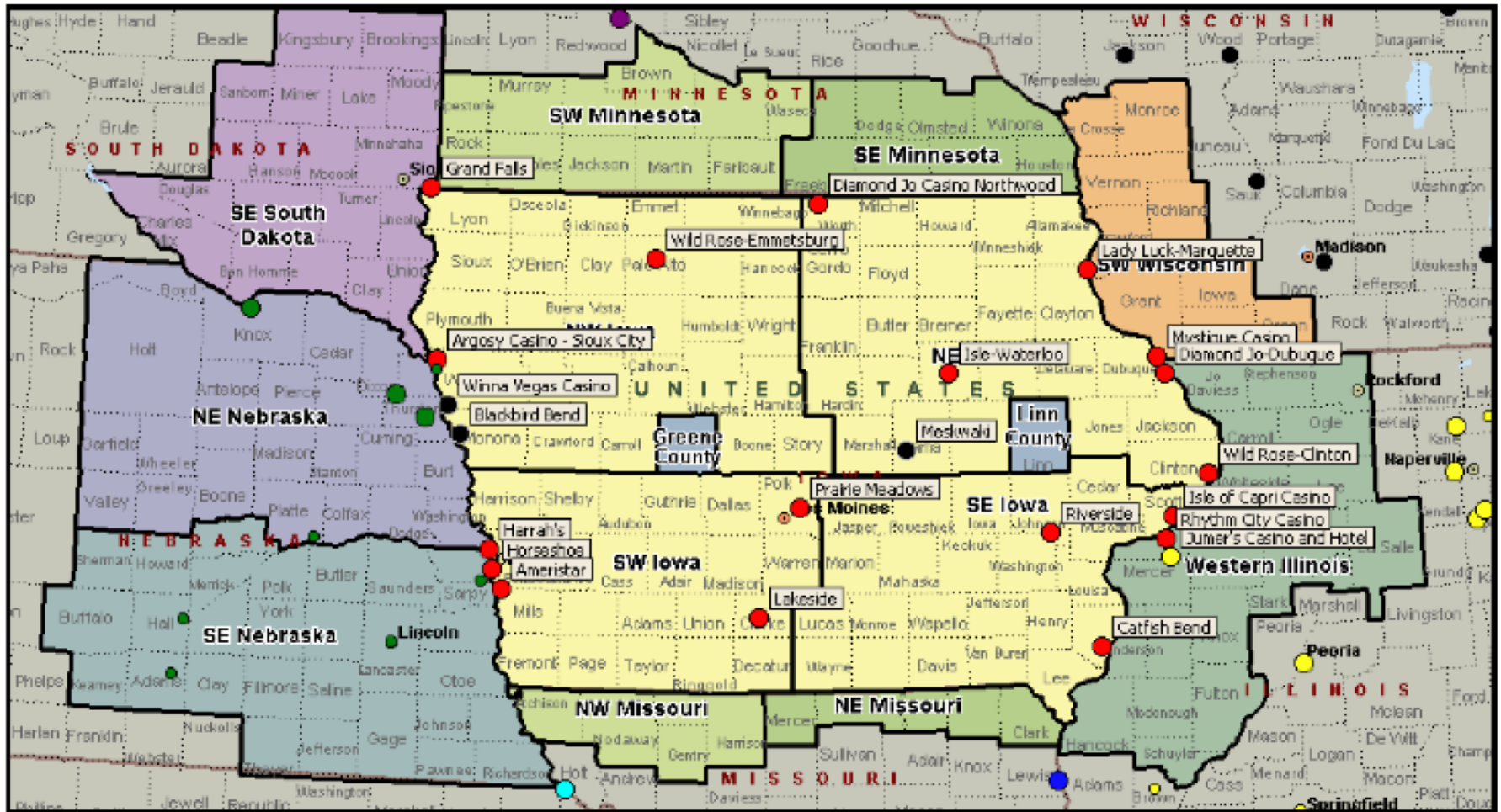


Exhibit 1: Key to Casinos and Geographic Zones

Casino Code	Year	State	Casino / Proponent	# slots	Lowest Proj'n (\$mn)	Highest Proj'n (\$mn)	Comments	Zone	Zone
1	2007-8	KS	generic for zone	na - 838	\$30.2	\$66.7	4 projections, including 2 synthetic	Kansas SW	SW
2	2008	KS	Dodge City Resort	800	\$46.5	\$63.0	3 projections		SW
3	2008	KS	Boot Hill / Butler Nat'l	875	\$47.2	\$70.9	3 projections . . . actual result: \$43.3 million	Kansas SE	SE
4	2008	KS	Penn National	900	\$37.2	\$93.9	4 projections, including 1 generic for the zone		SE
5	2008	KS	Harrahs	2,000	\$202.0	\$271.6	4 projections, including 1 generic for the zone	Kansas SC1	SCA
6	2009	KS	Lakes Gaming	2,000	\$192.8	\$230.0	3 projections at full build-out		SCA
7	2010	KS	Peninsula Gaming	1,655	\$184.1	\$202.8	3 projections . . . actual result: \$181.1 million	Kansas SC2	SCA
8	2008	KS	generic for zone	1,603-1,750	\$132.1	\$156.0	3 projections, including 2 synthetic		SCB
9	2008	KS	Penn National Gaming	1,500	\$125.7	\$214.4	3 projections		SCB
10	2008	KS	Marvel Gaming	2,000	\$128.4	\$230.4	3 projections		SCB
11	2010	KS	Global Gaming	1,675	\$114.6	\$148.5	3 projections	Kansas NE	SCB
12	2007-8	KS	generic for zone	na - 2,786	\$173.3	\$271.2	4 projections, including 2 synthetic		NE
13	2008	KS	Speedway / Cordish	3,000	\$226.7	\$358.1	3 projections		NE
14	2009	KS	Speedway / Penn Nat'l	2,300	\$158.3	\$220.2	3 projections . . . actual result: \$132.0 million		NE
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16	2008	KS	Pinnacle Entertainment	2,300	\$193.2	\$413.5	3 projections		NE
17	2008	KS	Legends Sun	2,000	\$163.4	\$295.6	3 projections	NE	
18	2009	IA	Grand Falls Resort	900±	\$60.0	\$71.4	3 projections . . . actual result: \$59.2 million	NW Iowa	Lyon
19	2013-14	IA	Wild Rose Jefferson	525±	\$28.0	\$34.3	3 projections	Central IA	Greene
20	2013-14	IA	Cedar Crossing	840	\$75.2	\$82.3	3 projections	SE Iowa	Cedar
21	2012-13	MA	Plainridge Park	1,250	\$198.6	\$256.6	3 proj'ns . . . actual result: \$154.6 million (proj'd)	"slot parlor"	slotp
22	2013	MD	Penn National	3,000	\$412.6	\$559.9	3 projections	PrGeoCo	PGCo
23	2013	MD	Parx	4,750	\$617.3	\$809.0	3 projections		PGCo
24	2013	MD	MGM Grand	3,600	\$688.3	\$712.6	3 projections		PGCo
25	2015	KS	Camptown	750	\$34.6	\$52.4	3 projections	Kansas SE	SE
26	2015	KS	Kansas Crossing	625	\$36.6	\$47.2	3 projections		SE
27	2015	KS	Castle Rock	1,400	\$47.8	\$91.7	4 projections (essentially same location as #4)		SE

■ indicates casino actually built

■ same casino compared to generic zone projections

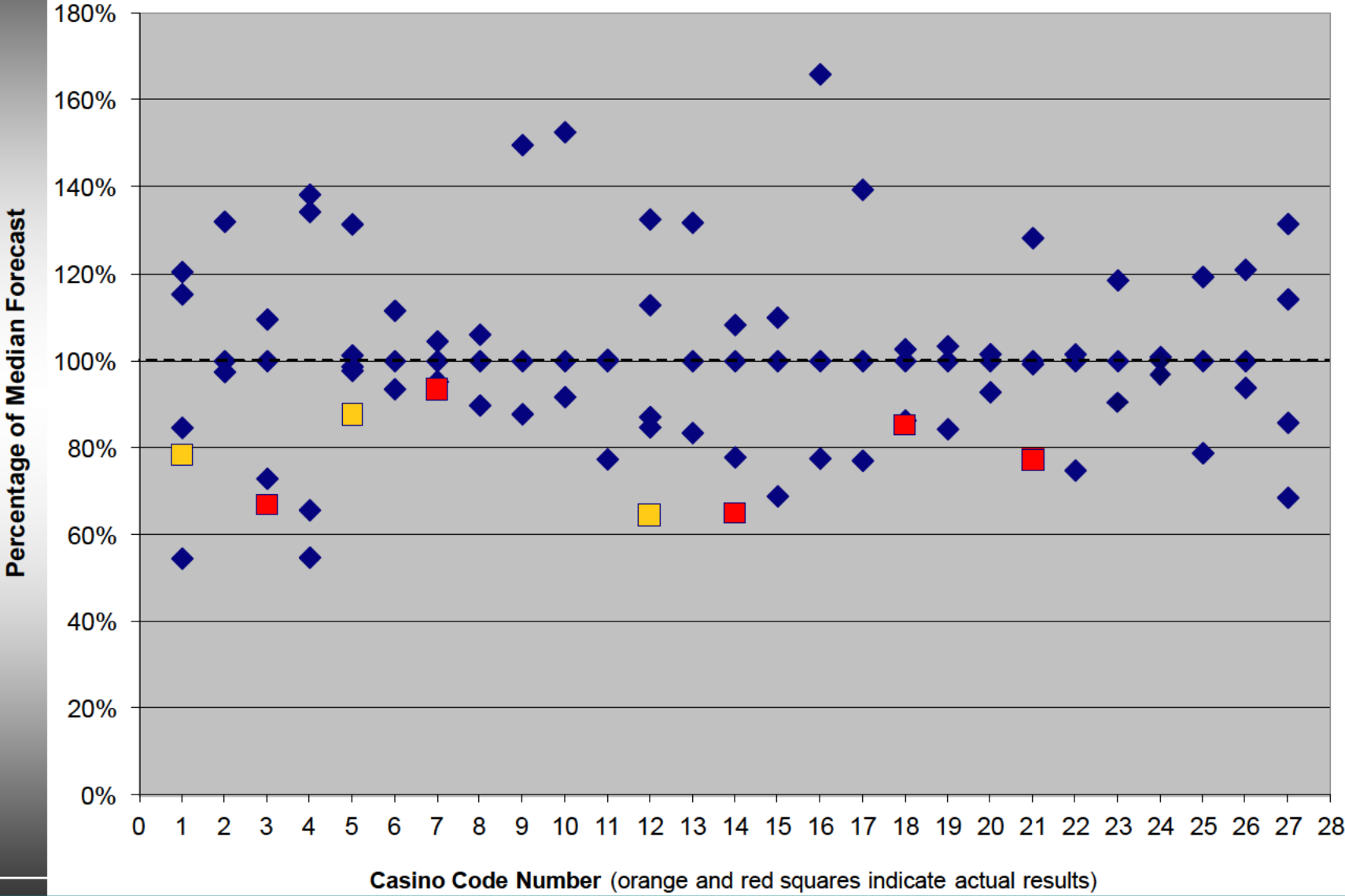
Exhibit 2: Data Points / Sources

ID #	Mnem.			Casino					Proj'n (\$mn)	Source *	Characteristics ◇ / Comments		
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2	KS1	KS	SW	2008	1	generic	686	\$66.7	CCA	M	I	FG	
3	KS1	KS	SW	2008	1	Expert 1 average	838	\$46.9	KRGC / expert 1	M	I	FG	
4	KS1	KS	SW	2008	1	Expert 2 average	838	\$63.9	KRGC / expert 2	M	I	BB	
5	KS2	KS	SW	2008	2	Dodge City Resort	800	\$47.7	KRGC / applicant	M	I	CG	
6	KS2	KS	SW	2008	2	Dodge City Resort	800	\$46.5	KRGC / expert 1	M	I	FG	
7	KS2	KS	SW	2008	2	Dodge City Resort	800	\$63.0	KRGC / expert 2	M	I	BB	
8	KS3	KS	SW	2008	3	Boot Hill	875	\$70.9	KRGC / applicant	M	I	na	
9	KS3	KS	SW	2008	3	Boot Hill	875	\$47.2	KRGC / expert 1	M	I	FG	
10	KS3	KS	SW	2008	3	Boot Hill	875	\$64.7	KRGC / expert 2	M	I	BB	
11	KS3	KS	SW	FY13	3	Boot Hill	700	\$43.3	KRGC / actual operating results (Year 3)			(green shading indicates actual results)	
12	KS4	KS	SE	2007		generic	na	\$148.5	CBRE	C	I	na	
13	KS4	KS	SE	2008		generic	1,660	\$161.6	CCA	C	I	FG	
14	KS4	KS	SE	2008	4	generic	965	\$93.9	CCA	C	I	FG	
15	KS4	KS	SE	2008	4	Penn Nat'l	900	\$91.2	KRGC / applicant	C	P	FG	
16	KS4	KS	SE	2008	4	Penn Nat'l	900	\$37.2	KRGC / expert 1	C	I	FG	
17	KS4	KS	SE	2008	4	Penn Nat'l	900	\$44.6	KRGC / expert 2	C	I	BB	
18	KS5	KS	SCA	2007		generic	na	\$160.2	CBRE	C	I	na	
19	KS5	KS	SCA	2008	5	generic	2,150	\$209.3	CCA	M	I	FG	
20	KS5	KS	SCA	2008	5	Harrahs	2,000	\$271.6	KRGC / applicant	M	P	CG	
21	KS5	KS	SCA	2008	5	Harrahs	2,000	\$202.0	KRGC / expert 1	M	I	FG	
22	KS5	KS	SCA	2008	5	Harrahs	2,000	\$203.9	KRGC / expert 2	M	I	BB	
23	KS6	KS	SCA	2009	6	Lakes	2,000	\$230.0	KRGC / applicant	M	P	na	
24	KS6	KS	SCA	2009	6	Lakes	2,000	\$192.8	KRGC / expert 1	M	I	FG	
25	KS6	KS	SCA	2009	6	Lakes	2,000	\$206.1	KRGC / expert 2	M	I	BB	
26	KS7	KS	SCA	2010	7	Peninsula	1,655	\$184.1	KRGC / applicant	M	P	CG	
27	KS7	KS	SCA	2010	7	Peninsula	1,655	\$202.8	KRGC / expert 1	M	I	FG	
28	KS7	KS	SCA	2010	7	Peninsula	1,655	\$194.0	KRGC / expert 2	M	I	BB	
29	KS7	KS	SCA	FY14	7	Peninsula / Boyd	1,825	\$181.1	KRGC / actual operating results (Year 2.5)				
93	KS20	KS	SE	2015	27	Castle Rock	1,400	\$59.8	KRGC / expert 1	C	I	FG	
94	KS20	KS	SE	2015	27	Castle Rock	1,400	\$47.8	KRGC / expert 5	C	I	CG	

* KRGC = Kansas Racing and Gaming Commission, IRGC = Iowa ditto, MDL&GCA = Maryland Lottery & Gaming Control Agency, MGC = Mass. Gaming Commission

Results

Exhibit 3: Forecast Variation by Time and Place - Each Location



Statistics - Overall

- Among projections that are not themselves the median, the mean difference from the median is 18.7%
 - Median difference = 15.4%
- Mean pairwise difference between any two projections for the same casino is 26.1%
 - Median pairwise difference = 19.7%

Statistics - Provenance

- “Independent” projections average lower than “partisan” projections by 24% of the relevant median
 - Excluding outlier KCKS: -19%
- Mean pairwise differences:
 - Between independent proj'ns: 19%
 - Partisan vs. independent: 29%

Statistics – Type of Market

- Less dispersion among projections for monopoly/oligopolistic markets than for highly competitive ones
 - Monopoly Markets: 24%
 - Oligopolistic " : 13%
 - Competitive " : 35%

Exhibit 4: Forecast Variation by Magnitude of Median Projection

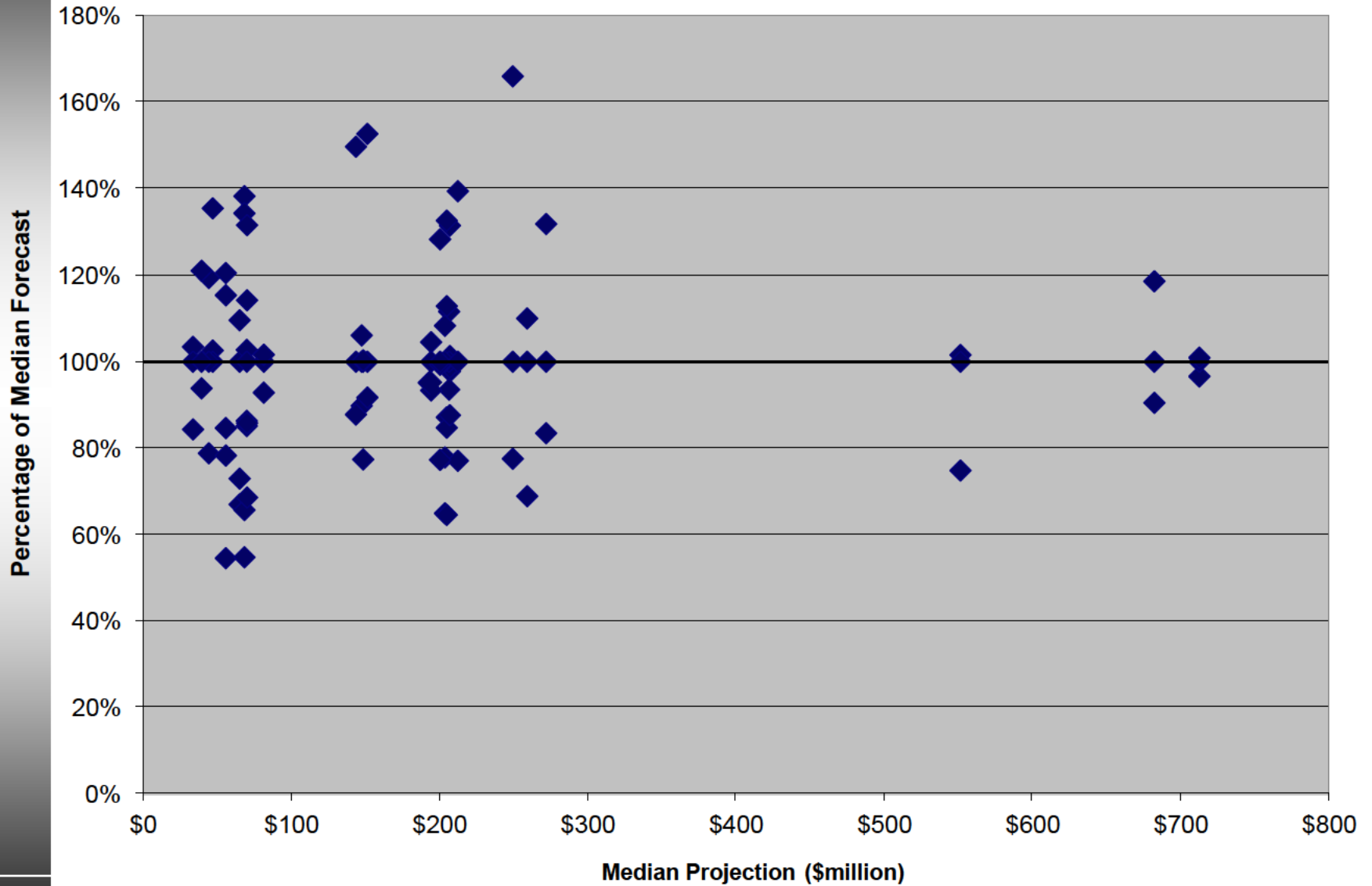
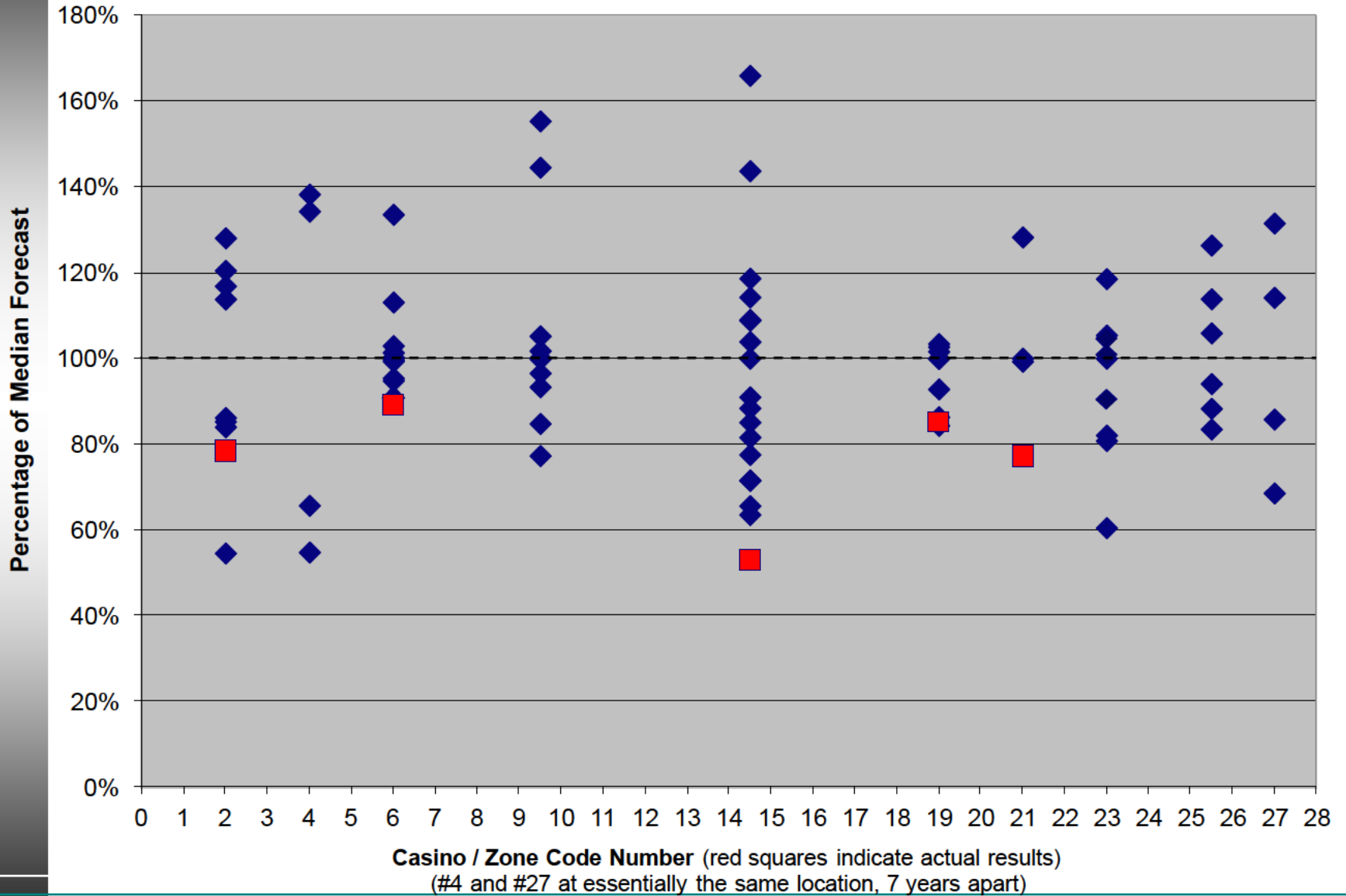


Exhibit 5: Forecast Variation by Aggregate Location / Geographic Zone



Statistics – By Zone

- Among projections that are not themselves the median, the mean difference from the median is 17.3%
 - Median difference = 14.2%
- Mean pairwise difference between any two projections in any particular zone is 25.9% (vs. 26.1% for each property alone)
 - Median pairwise difference = 19.5%

No Findings re “Methods”

- Too few “pure” examples of each type
- Treatment of “Everything Else” probably dominates
- Distance/Size relationships **may** matter, but are rarely disclosed explicitly

Forecasts vs. Actuals

Exhibit 5: Forecast Variation by Aggregate Location / Geographic Zone

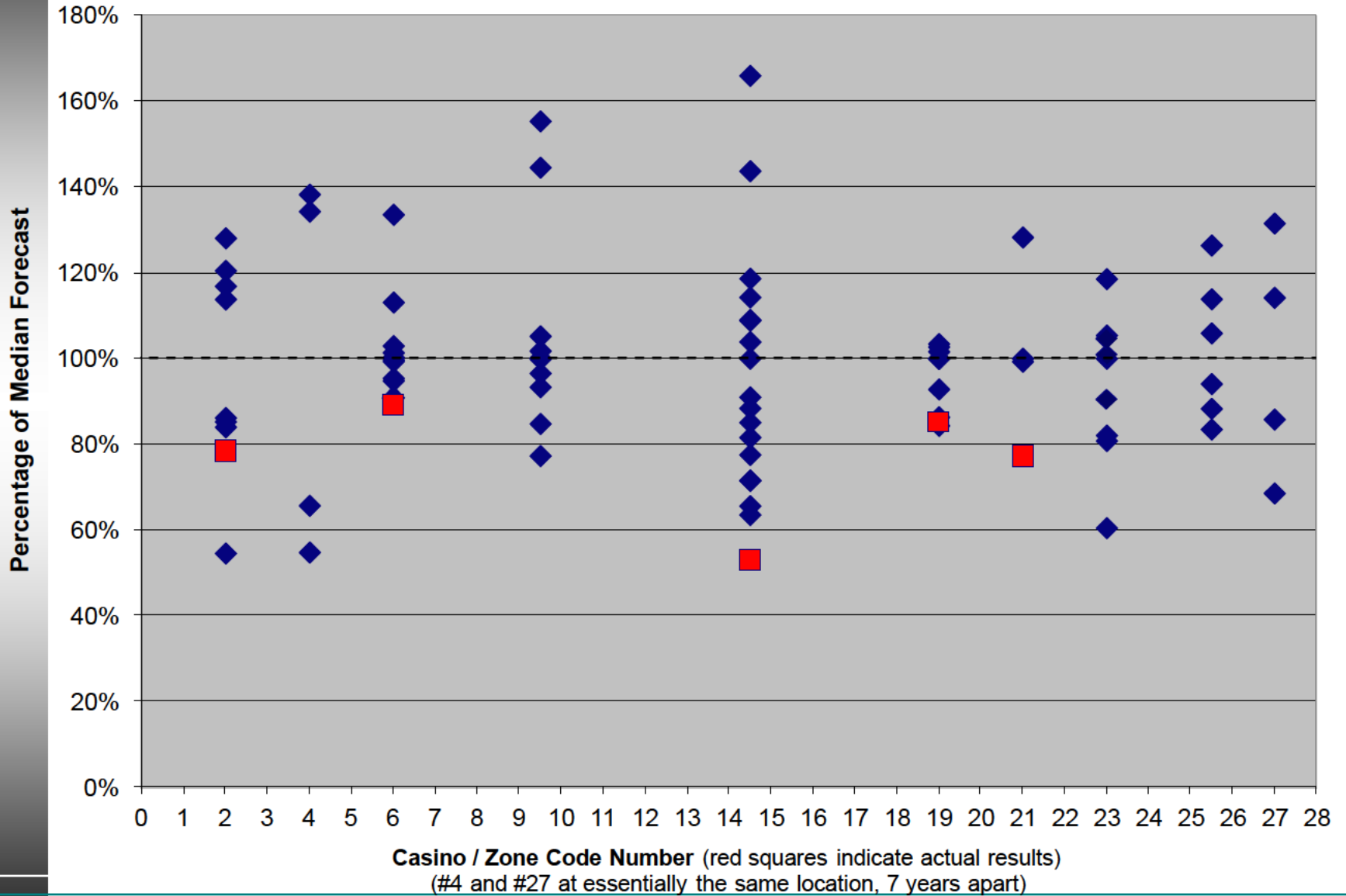
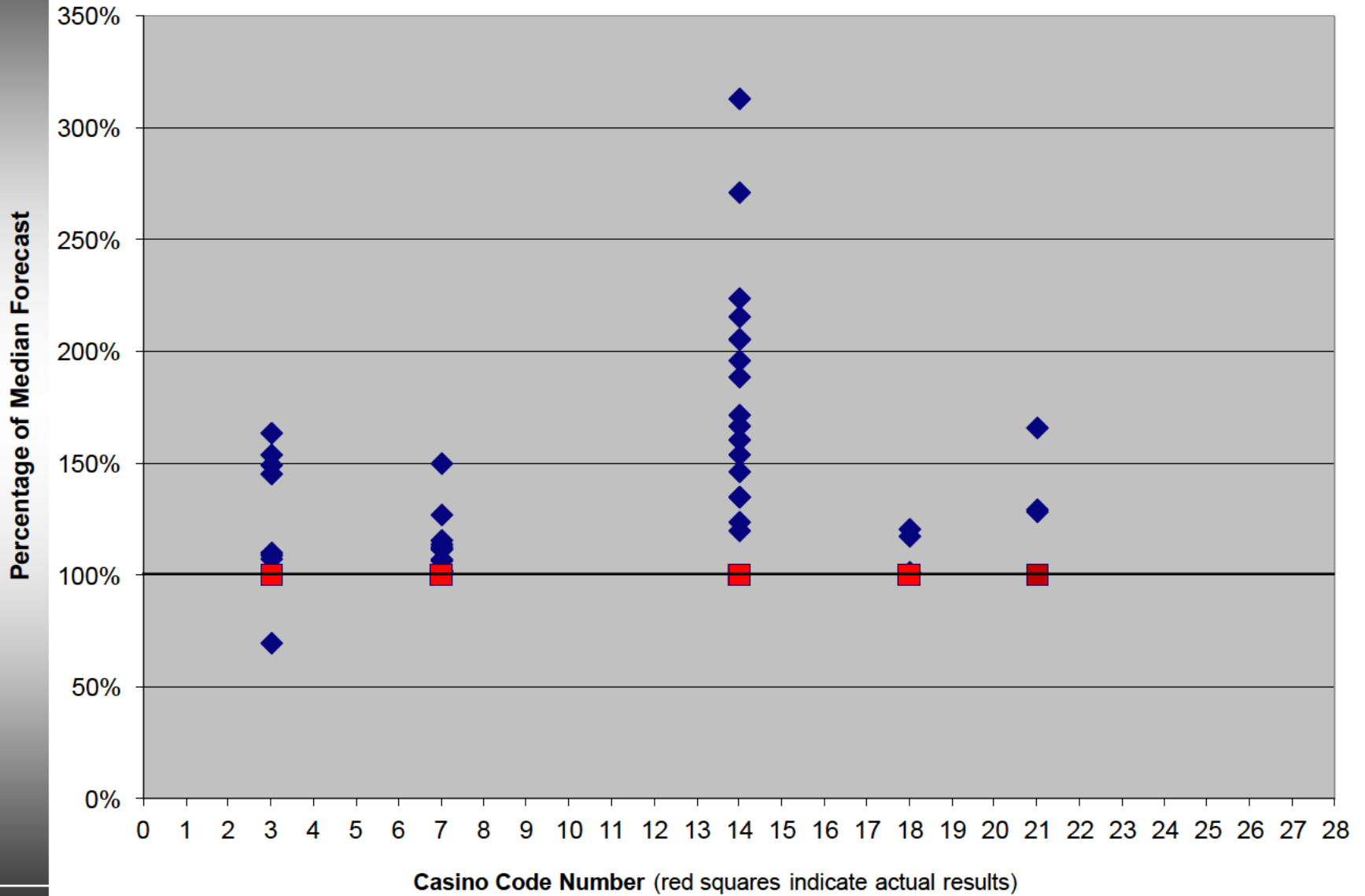


Exhibit 6: Forecast (Broadly Defined) Versus Actual Performance



Five Casinos Actually Built

- The mean difference from actual results (ideally, 3rd year) is 48% (N=41)
 - Median difference = 35%
- Excluding outlier KCKS (N=24), the mean difference is 21.5%
 - Median difference = 13.2%
- Only **one** of 41 projections was low (none of the 24 for KCKS)

Bottom Line

- Dispersion of results is wide
- “Gravity Models” ...
 - Nonlinear
 - Underdetermined
 - Proprietary
- Not subjected to rigorous estimation / precision is low
- Rx: Take with a large grain of salt

2012 GDP Forecasts Vs. 2008 GDP Forecasts

Source: WSJ Survey of Economists Dec 2007 & Dec 2011

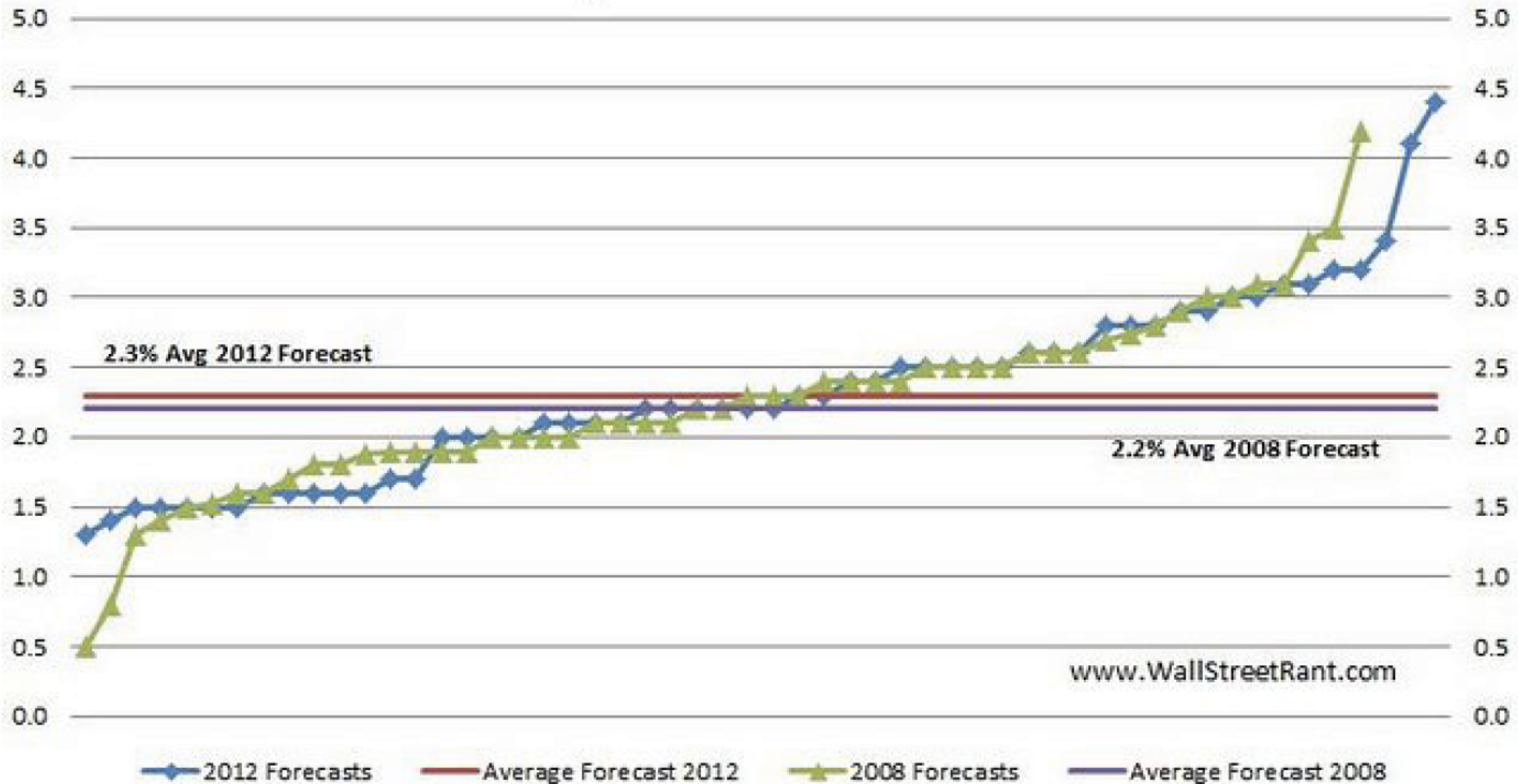
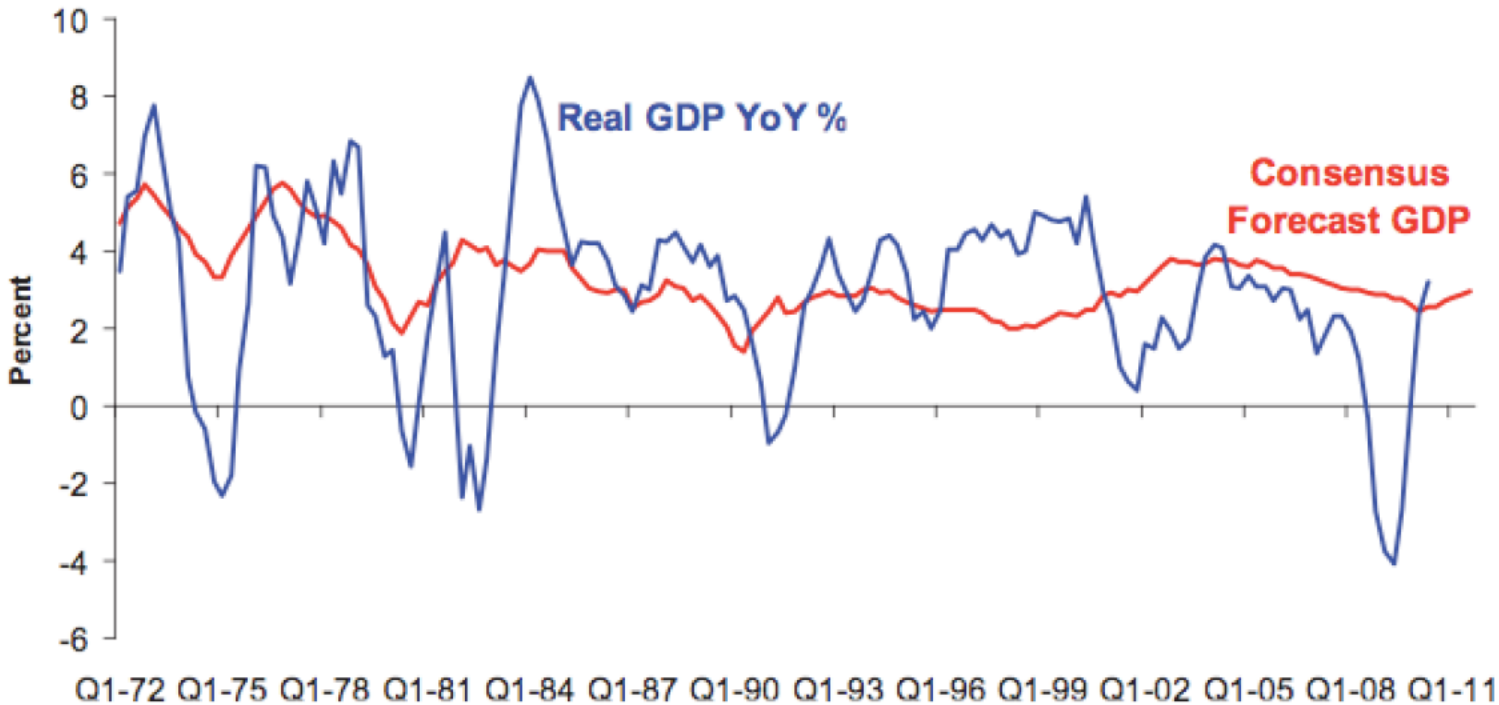


Exhibit 4: Economists Can't Forecast for Toffee (GDP % YoY, 4q ma)



Source: Federal Reserve Bank of Philadelphia Actual data through Jun 2010; projection through Sep 2011

Source: Blodgett, 2011



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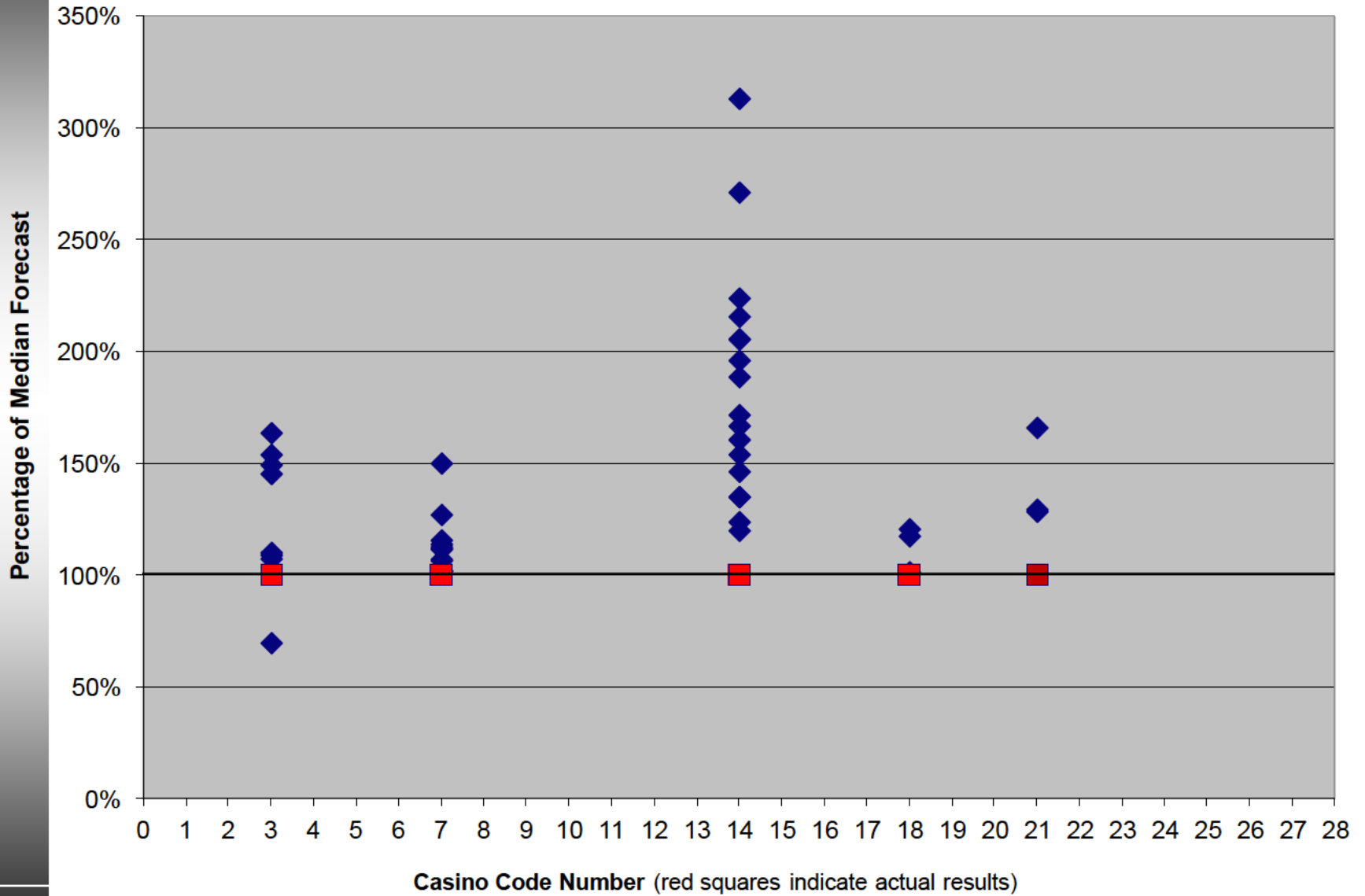
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Exhibit 6: Forecast (Broadly Defined) Versus Actual Performance












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Alternative Versions

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 indicates casino actually built


 same casino compared to generic zone projections

Exhibit 2: Data Points / Sources

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9	KS3	KS	SW	2008	3	Boot Hill	875	\$47.2	KRGC / expert 1	M	I	FG
10	KS3	KS	SW	2008	3	Boot Hill	875	\$64.7	KRGC / expert 2	M	I	BB
11	KS3	KS	SW	FY13	3	Boot Hill	700	\$43.3	KRGC / actual operating results (Year 3)			(green shading indicates actual results)
12	KS4	KS	SE	2007		generic	na	\$148.5	CBRE	C	I	na
13	KS4	KS	SE	2008		generic	1,660	\$161.6	CCA	C	I	FG
14	KS4	KS	SE	2008	4	generic	965	\$93.9	CCA	C	I	FG
15	KS4	KS	SE	2008	4	Penn Nat'l	900	\$91.2	KRGC / applicant	C	P	FG
16	KS4	KS	SE	2008	4	Penn Nat'l	900	\$37.2	KRGC / expert 1	C	I	FG
17	KS4	KS	SE	2008	4	Penn Nat'l	900	\$44.6	KRGC / expert 2	C	I	BB
18	KS5	KS	SCA	2007		generic	na	\$160.2	CBRE	C	I	na
19	KS5	KS	SCA	2008	5	generic	2,150	\$209.3	CCA	M	I	FG
20	KS5	KS	SCA	2008	5	Harrahs	2,000	\$271.6	KRGC / applicant	M	P	CG
21	KS5	KS	SCA	2008	5	Harrahs	2,000	\$202.0	KRGC / expert 1	M	I	FG
22	KS5	KS	SCA	2008	5	Harrahs	2,000	\$203.9	KRGC / expert 2	M	I	BB
23	KS6	KS	SCA	2009	6	Lakes	2,000	\$230.0	KRGC / applicant	M	P	na
24	KS6	KS	SCA	2009	6	Lakes	2,000	\$192.8	KRGC / expert 1	M	I	FG
25	KS6	KS	SCA	2009	6	Lakes	2,000	\$206.1	KRGC / expert 2	M	I	BB
26	KS7	KS	SCA	2010	7	Peninsula	1,655	\$184.1	KRGC / applicant	M	P	CG
27	KS7	KS	SCA	2010	7	Peninsula	1,655	\$202.8	KRGC / expert 1	M	I	FG
28	KS7	KS	SCA	2010	7	Peninsula	1,655	\$194.0	KRGC / expert 2	M	I	BB
29	KS7	KS	SCA	FY14	7	Peninsula / Boyd	1,825	\$181.1	KRGC / actual operating results (Year 2.5)			
93	KS20	KS	SE	2015	27	Castle Rock	1,400	\$59.8	KRGC / expert 1	C	I	FG
94	KS20	KS	SE	2015	27	Castle Rock	1,400	\$47.8	KRGC / expert 5	C	I	CG

* KRGC = Kansas Racing and Gaming Commission, IRGC = Iowa ditto, MDL&GCA = Maryland Lottery & Gaming Control Agency, MGC = Mass. Gaming Commission

◊ C = competitive market, M = monopoly, O = oligopoly, I = independent study, P = partisan, CG = 'coarse-grained' approach, FG = 'fine-grained', BB = 'black box'

Exhibit 3: Forecast Variation by Time and Place - Each Location

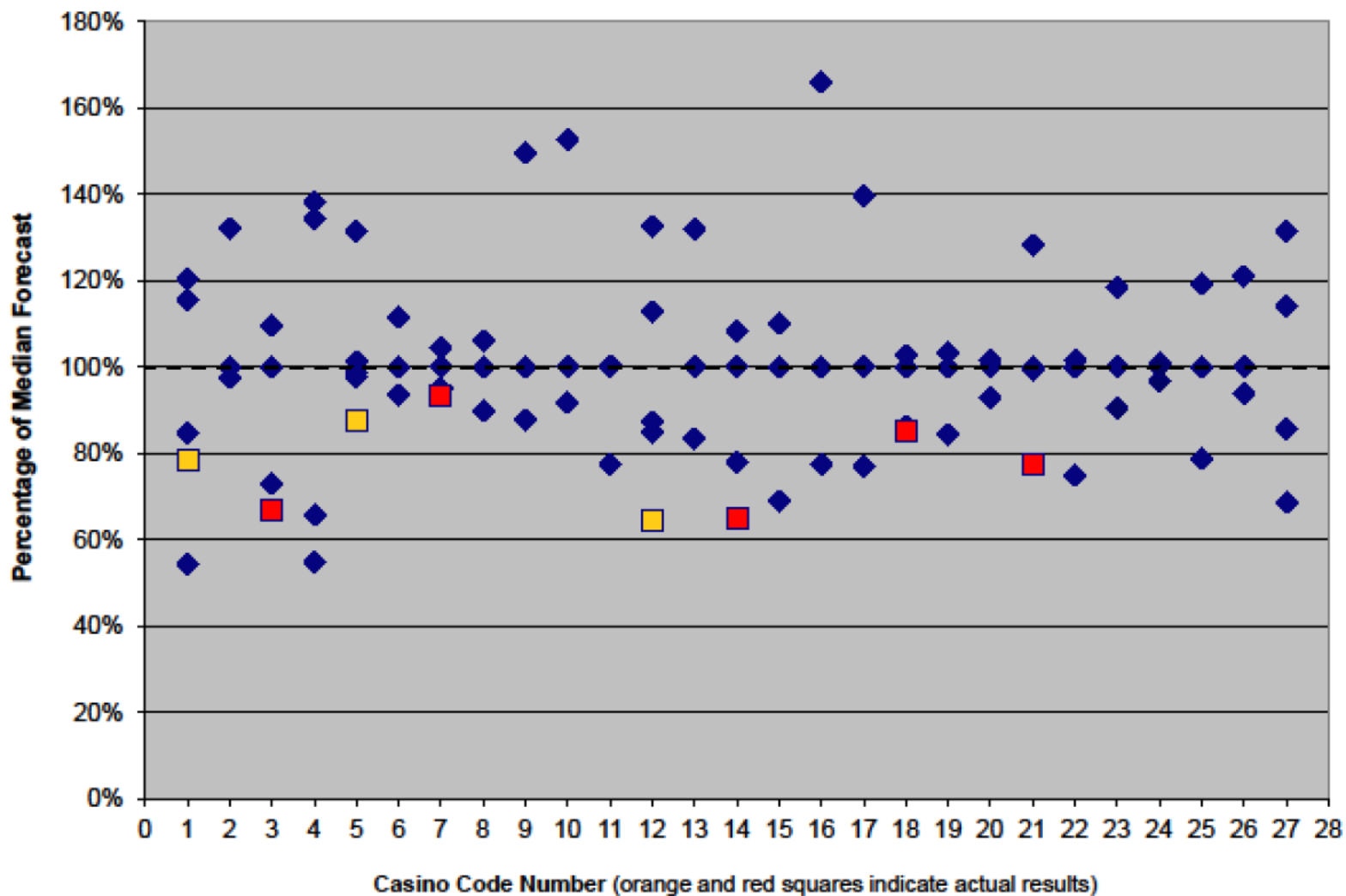


Exhibit 4: Forecast Variation by Magnitude of Median Projection

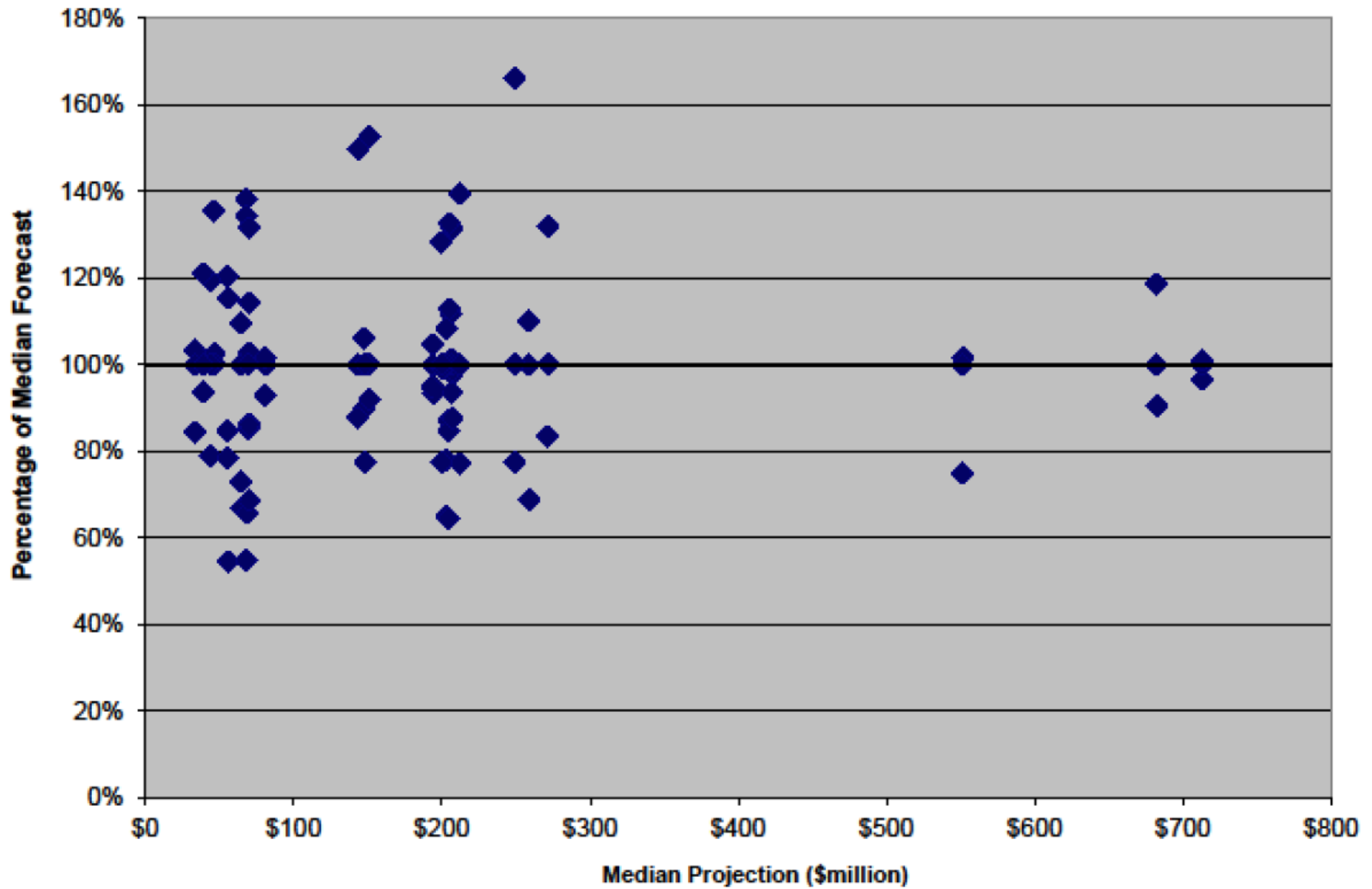


Exhibit 5: Forecast Variation by Aggregate Location / Geographic Zone

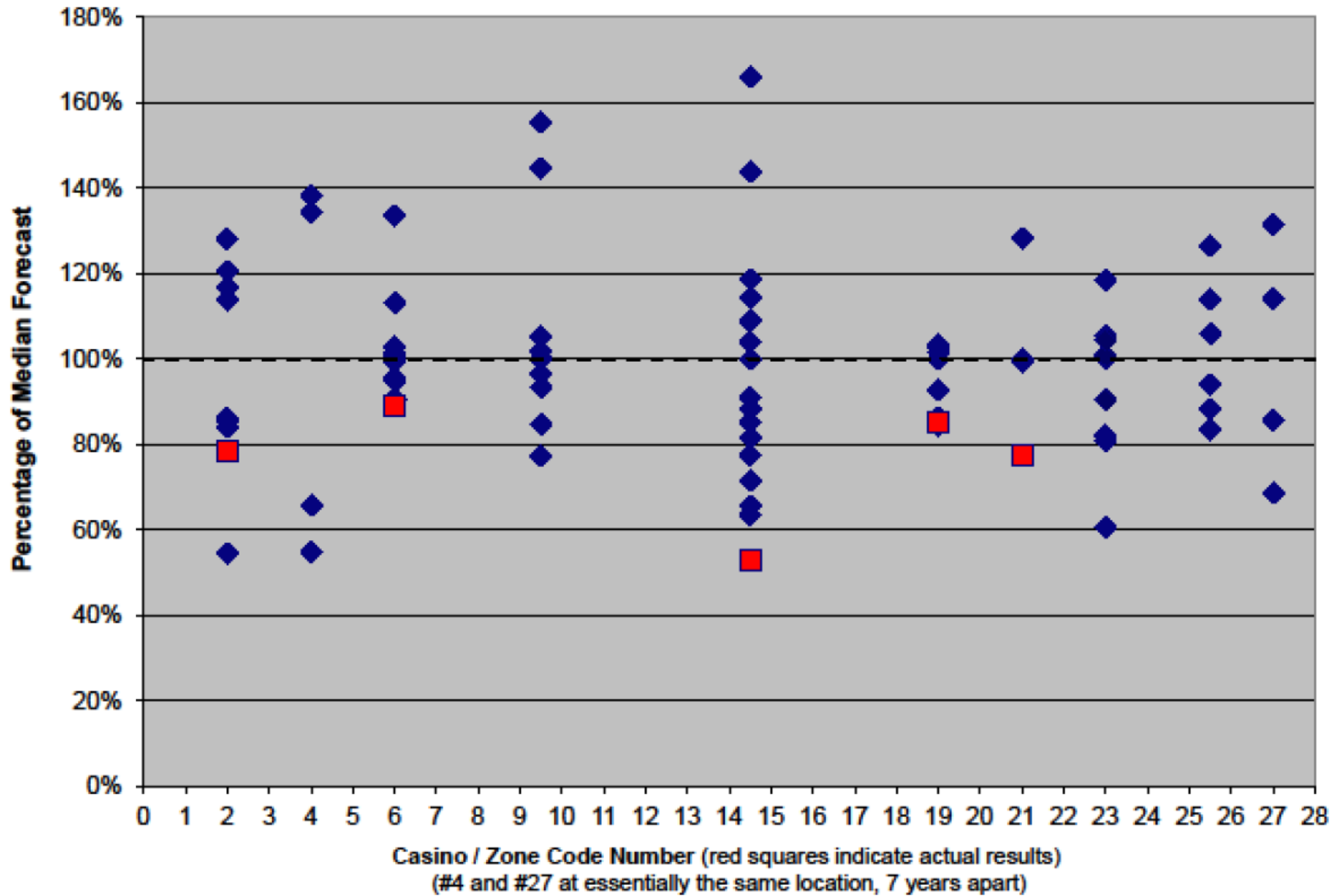


Exhibit 6: Forecast (Broadly Defined) Versus Actual Performance

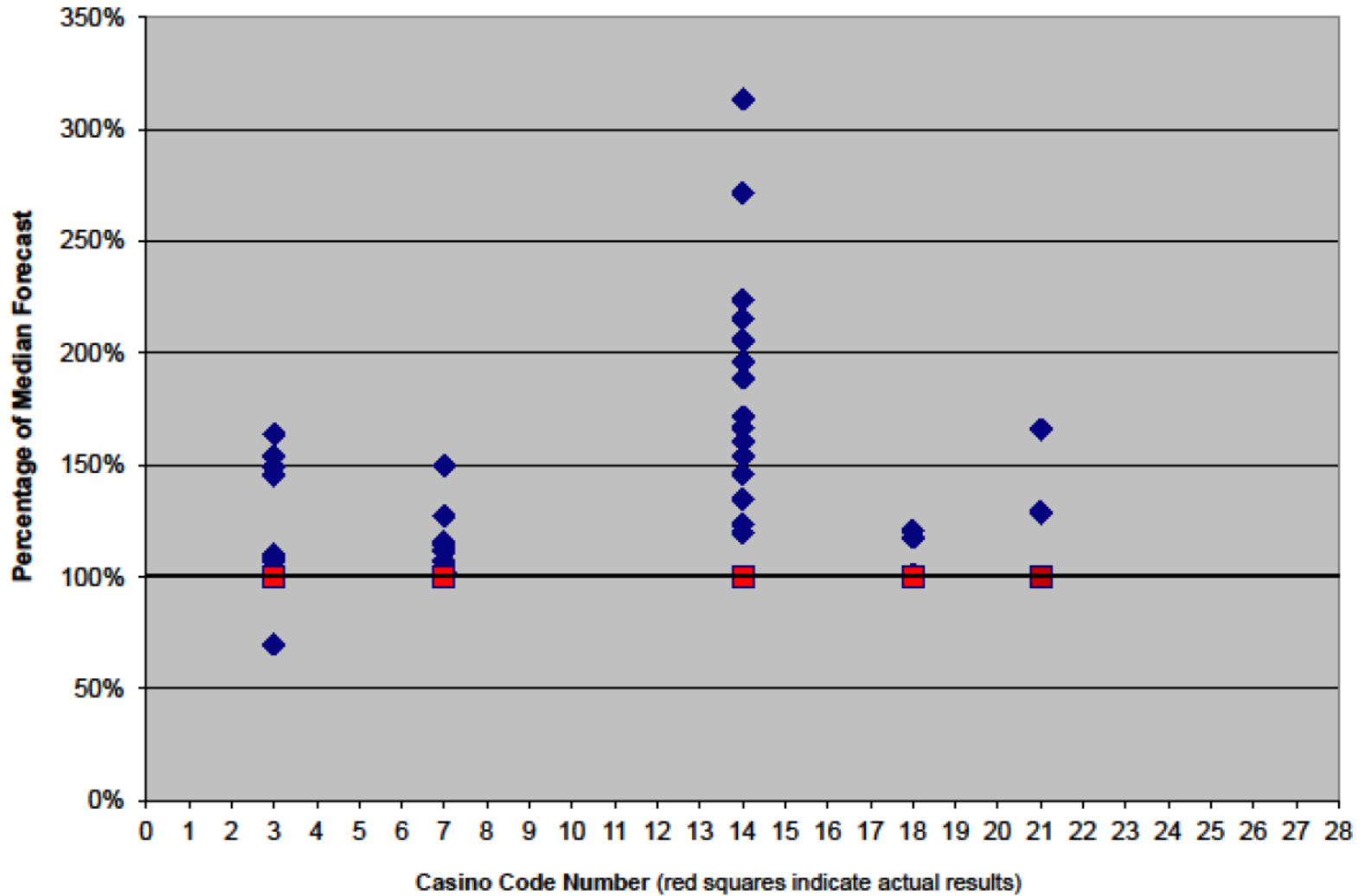


Exhibit 6: Forecast (Broadly Defined) Versus Actual Performance

