Rationality and Risk Intelligence in Binary Betting

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Data

- 1.6 million Internet bets on financial markets
- Over 21,000 bettors
- January 2008 to August 2010
- Average size US $375
- Bookmaker is anonymous large public company

Bettors

- Mass market retail bettors
  - Above average but not high income
  - 90% male
  - Median age 35
  - Typically not financial professionals
- Across Europe and Asia
  - Weighted toward UK and Japan
  - No US

Typical bets

- Binary, USD/EUR to be above 1.30 in one hour
- Touch, USD/EUR will be at or above 1.30 at some time in the next hour
- Tunnel, USD/EUR will be above 1.31 or below 1.29 at some time in the next hour
- 44 liquid indices to bet on, major stock indices and currency pairs
- Expiries of 5 minutes to several days

Quote

- Bettor designs bet from a menu, including size
- Bookmaker posts ask and bid prices
- Ask > bid
- Prices change continuously
- Bettor can transact continuously
  - Reverse earlier bet to lock in gain or loss
  - Add to earlier bet
  - Add new bet to change combined payoff profile

Execution

- Bettor can hit
  - ask (buys bet, meaning pays ask price but gets paid if statement is true), or
  - bid (sells bet, meaning gets price but pays if statement is true)
- >99% of bets accepted automatically
- <1% of bets based on size and bettor referred to human trader
- Rarely, trader will reject bet and change quote

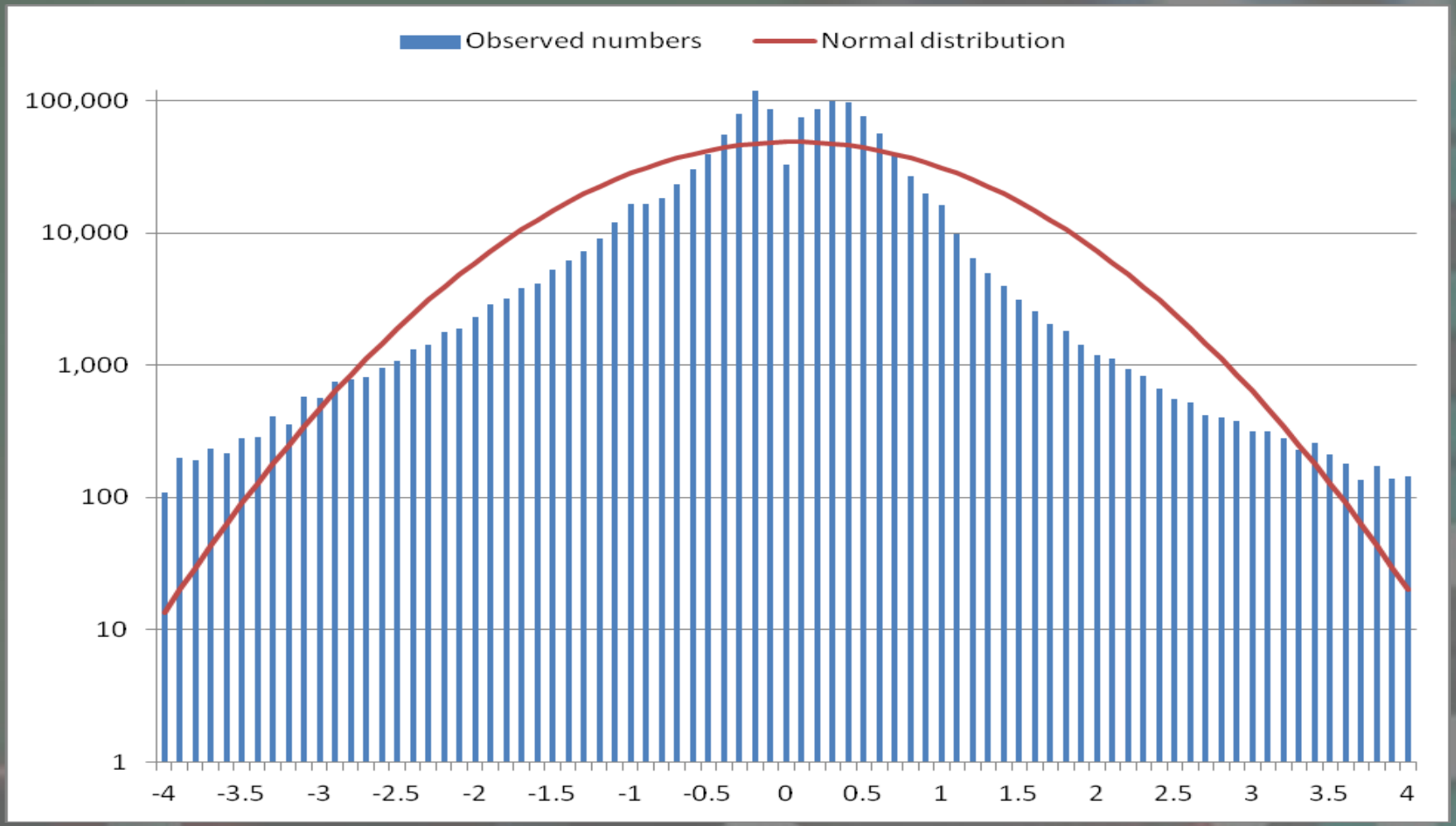
Bookmaker

- Starts with standard financial option pricing models
- Makes many ad hoc adjustments due to short-term nature of bets
- Employs traders who review bets and adjust quotes

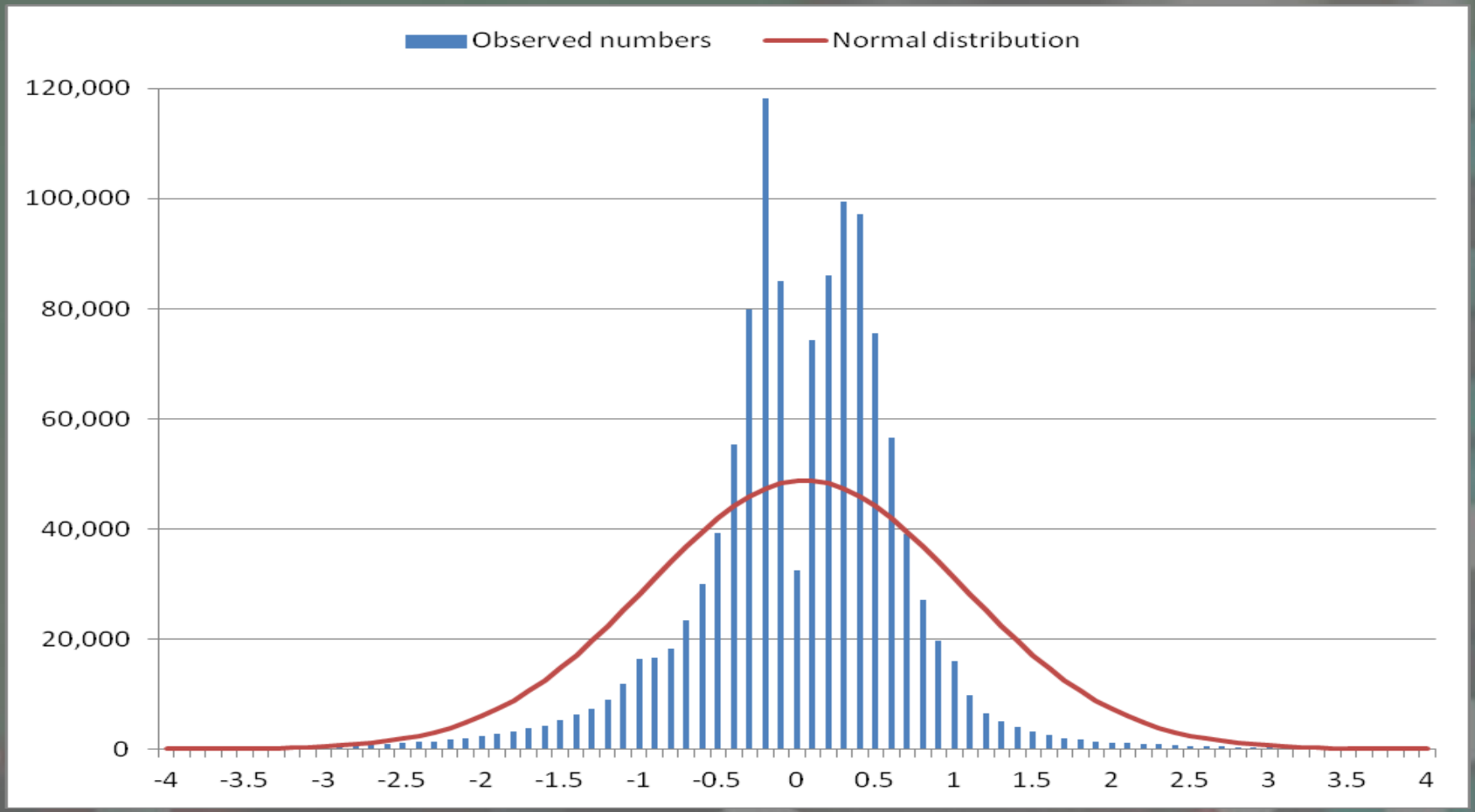
Traders

- Exhibit significant pricing skill that resists automation
- Watch for news events or financial market trends
- Track successful individual bettors
- Examine large or unusual bets
- Manage book to balance exposures
- Must respond nearly immediately

Log scale


Observed numbers
Normal distribution
100,000
10,000
1,000
100
10
1
-4
-3.5
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
4

Standard Deviation



Bettors have skill

Skill bucket	Number of bets	Average bet size	Average profit (loss)	Standardized profit (loss)	t-value
<(7)	2	157	24	0.19	0.2
(7)	7	28	4	(0.19)	(0.5)
(6)	6	46	(9)	0.20	0.5
(5)	23	208	(12)	(0.03)	(0.2)
(4)	2,169	278	(87)	(0.12)	(5.8)
(3)	20,780	192	(13)	(0.06)	(8.3)
(2)	87,976	365	(21)	(0.05)	(14.8)
(1)	413,879	414	(21)	(0.04)	(24.3)
0	568,648	552	(20)	(0.03)	(23.9)
1	97,248	410	(10)	0.00	1.2
2	18,737	253	22	0.05	7.1
3	4,273	441	69	0.13	8.5
4	38	218	(59)	(0.41)	(2.5)
5	4,441	238	90	0.15	9.8
6	1,898	789	93	0.10	4.5

Right tail

- 2,349 bettors placed more than 100 bets
- Compute standard deviation of performance assuming all bets are fair
- Expect 0.07 bettors to be more than 4 standard deviations above the mean by chance

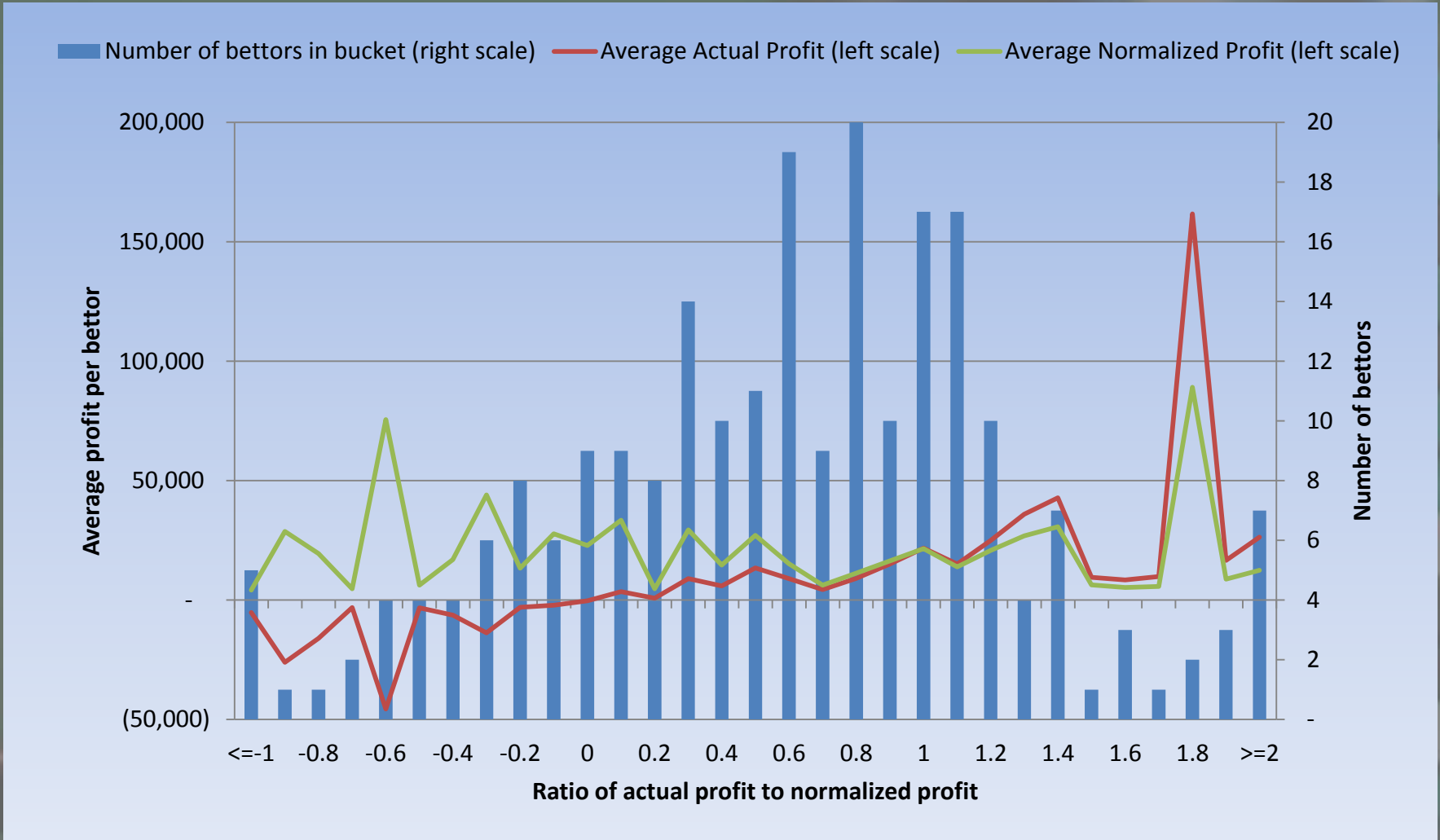
Top 11 t-values

Number of bets	t-value	Profit	Average bet Size	Normalized Profit	Profit / Normalized Profit
4,108	7.7	95,895	210	104,225	0.9
2,664	7.6	9,170	220	86,244	0.1
1,751	5.8	229,252	681	164,718	1.4
1,196	5.2	132,057	706	127,397	1.0
7,685	5.1	93,894	216	95,881	1.0
152	4.8	2,761	427	25,002	0.1
1,879	4.4	55,138	589	112,415	0.5
1,400	4.4	14,708	89	14,518	1.0
489	4.2	4,556	62	5,838	0.8
204	4.0	239,278	2,278	130,489	1.8
267	4.0	15,969	225	14,536	1.1

Next 12 t-values

Number of bets	t-value	Profit	Average bet size	Normalized Profit	Profit / Normalized Profit
354	3.8	(1,784)	924	65,858	(0.0)
113	3.8	3,583	144	5,742	0.6
781	3.7	10,594	903	94,600	0.1
235	3.6	19,401	375	20,907	0.9
275	3.6	10,809	113	6,644	1.6
195	3.5	8,328	160	7,849	1.1
303	3.4	9,032	158	9,240	1.0
1,124	3.3	8,658	76	8,454	1.0
329	3.3	19,938	851	50,615	0.4
983	3.2	34,060	309	31,424	1.1
127	3.2	4,860	143	5,170	0.9
11,997	3.0	(169,263)	849	280,949	(0.6)

>100 Bets, > 1 SD


Number of bettors in bucket (right scale)
Average Actual Profit (left scale)
Average Normalized Profit (left scale)
200,000
150,000
100,000
50,000
-
(50,000)
Average profit per bettor
20
18
16
14
12
10
8
6
4
2
-
Number of bettors
<=-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
>=2
Ratio of actual profit to normalized profit

Size matters

Size bucket	Number of bets	Average bet size	Average profit (loss)	Std profit (loss)	t-value
<10%	51,001	67	(1.64)	(0.0267)	(6.0)
14%	53,961	111	(2.61)	(0.0241)	(5.6)
22%	108,684	135	(2.00)	(0.0181)	(6.0)
37%	194,702	172	(2.49)	(0.0202)	(8.9)
61%	295,240	222	(3.69)	(0.0179)	(9.7)
100%	280,591	344	(6.32)	(0.0320)	(17.0)
165%	138,709	702	(25.20)	(0.0498)	(18.5)
272%	61,012	1,350	(76.09)	(0.0678)	(16.7)
448%	23,222	2,426	(165.70)	(0.0779)	(11.9)
739%	8,383	4,288	(312.96)	(0.0895)	(8.2)
>1,000%	4,620	17,134	(862.00)	(0.0753)	(5.1)

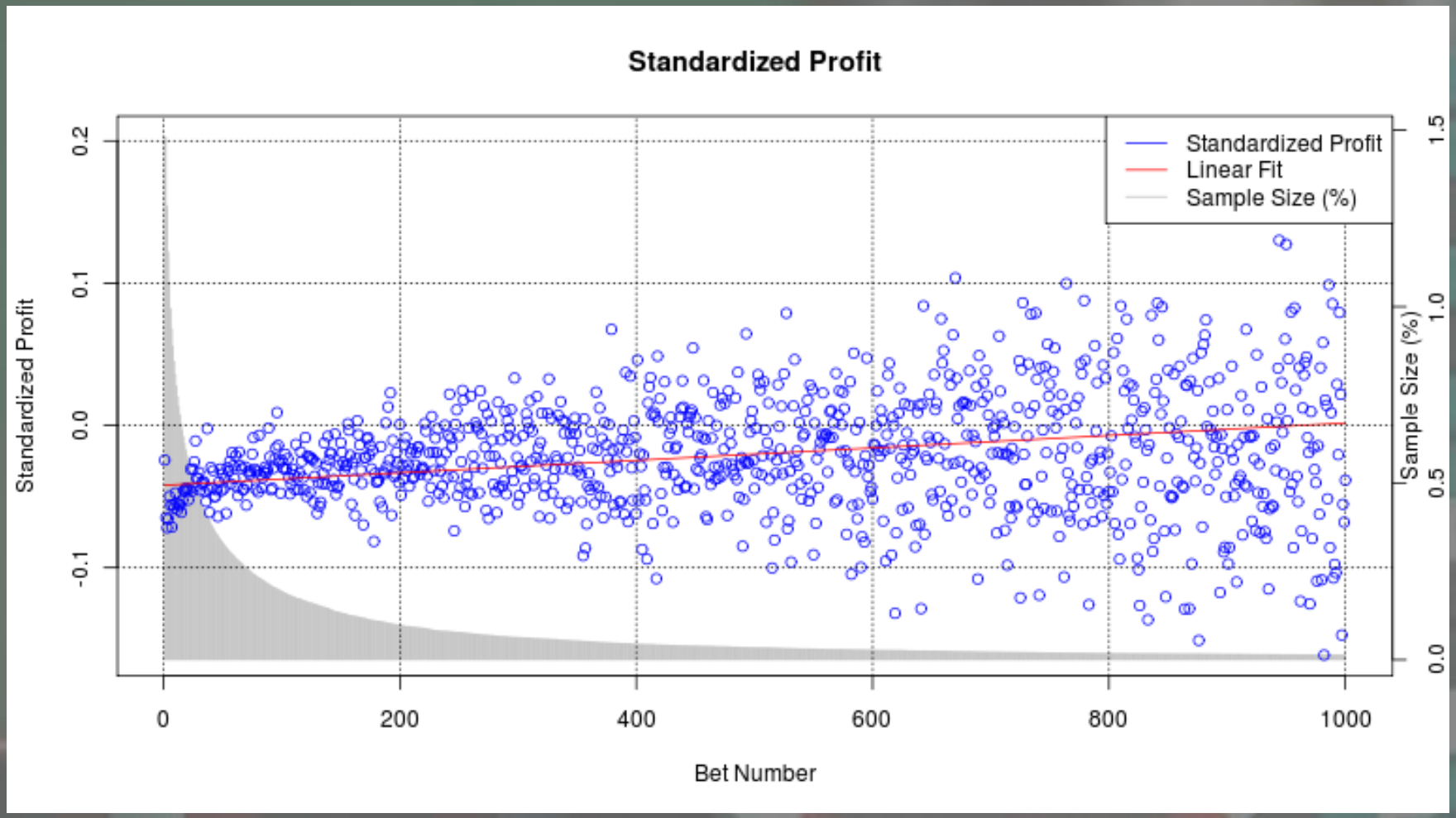
Cross tabulation of bets

		Midpoint of size bucket										
		<10%	14%	22%	37%	61%	100%	165%	272%	448%	739%	>1,000%
SKILL BUCKET	-9							1				
	-8							1				
	-7		2			2	3					
	-6				1	1	2	2				
	-5			4	1	2	7	6	1	2		
	-4	52	175	139	266	462	687	250	66	52	8	12
	-3	54	254	879	2,755	8,214	4,977	2,197	938	310	141	61
	-2	1,590	2,374	4,627	12,410	23,776	26,307	10,706	4,130	1,366	468	222
	-1	10,552	15,023	35,222	65,112	104,948	101,324	48,320	21,180	7,914	2,790	1,494
	0	35,856	32,090	57,247	94,605	125,737	117,417	60,749	27,332	10,954	4,138	2,523
	1	2,373	3,042	7,598	15,128	23,762	23,539	13,488	5,549	1,919	617	233
	2	196	642	2,344	3,081	4,457	4,431	1,895	1,055	412	161	63
	3	245	184	313	460	1,157	923	585	267	115	18	6
	4	1	1	2	4	4	6	6	9	3	2	
	5	3	1	32	606	2,383	676	258	316	124	36	6
	6	79	173	277	273	335	292	245	169	51	4	

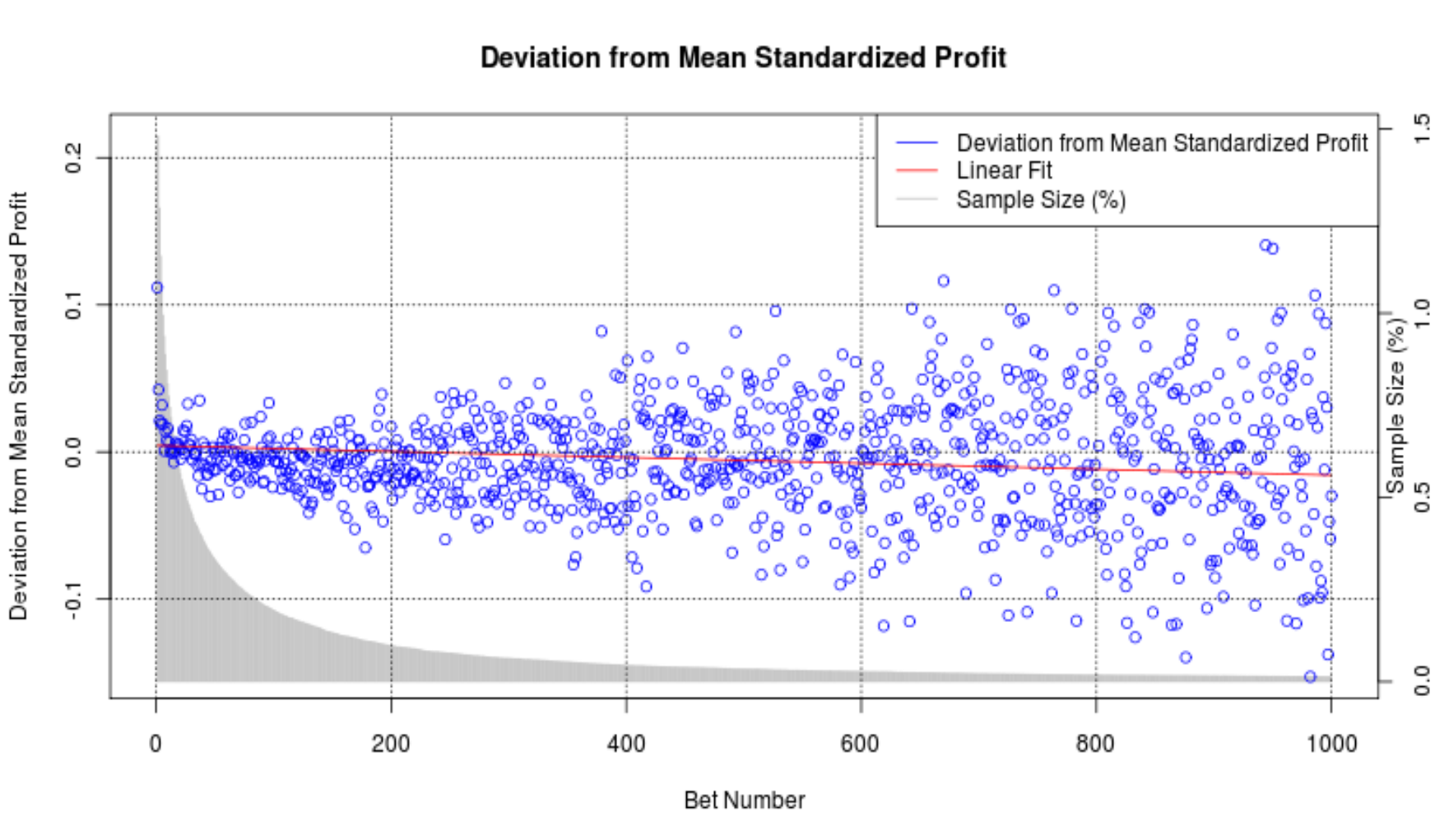
Returns

		Midpoint of size bucket										
		<10%	14%	22%	37%	61%	100%	165%	272%	448%	739%	>1,000%
SKILL BUCKET	(4)						-15.7%	-21.2%	-26.2%			
	(3)					-4.9%	-6.4%					
	(2)			-5.5%	-5.4%	-3.7%	-5.1%	-4.2%	-8.5%	-10.3%	-10.1%	
	(1)	-4.1%	-4.2%	-2.8%	-2.6%	-2.7%	-3.2%	-6.4%	-7.5%	-8.5%	-9.7%	-10.0%
	0	-2.3%	-1.4%	-1.5%	-1.8%	-1.9%	-4.0%	-5.6%	-8.0%	-8.4%	-8.5%	-5.4%
	1				1.8%	2.6%			-3.3%	-5.0%	-9.4%	
	2				4.1%		8.0%	8.9%	9.0%			
	3					11.8%	14.3%	17.0%	17.2%			
	4											
	5					15.4%	17.5%	30.3%	26.6%			
	6						12.5%	13.3%				

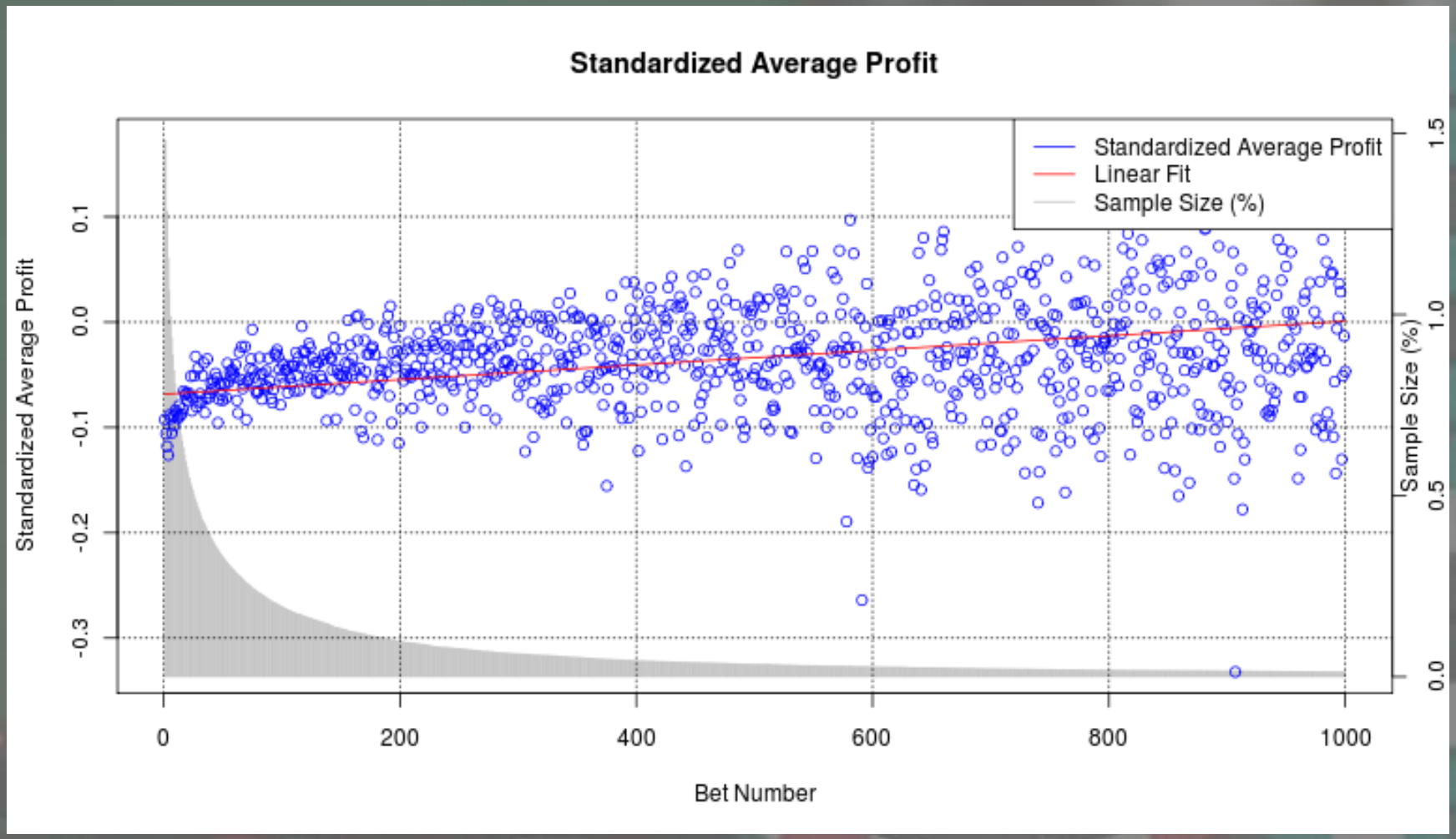
Do bettors learn?



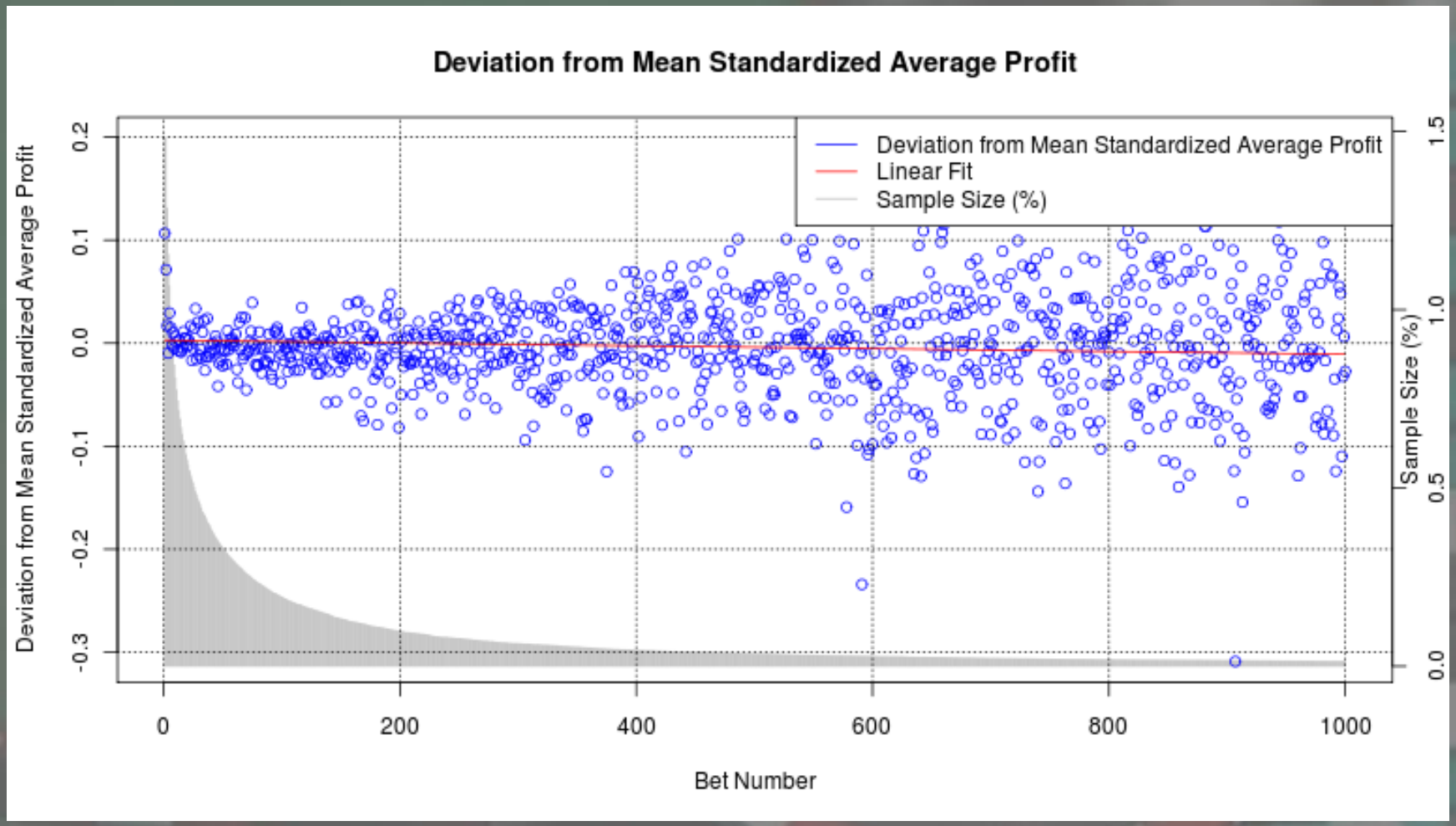
Learning or attrition?



Effect of varying bet sizes



And adjusting for bettor average



Conclusions

- Bettors have skill
- Few bettors continue to play in the face of statistical evidence of negative expected return
- More negative risk intelligence than positive, but significant amounts of both
- Increasing betting skill correlated with increased risk intelligence
- But negative risk intelligence common even among top skill bettors
- Losing bettors are not random
- Little learning, in fact apparent negative learning in skill
- Some learning in risk intelligence

Further projects

- Investigate nature of bettor skill
- Can losing bettors be trained to win, given that they have information?
- Do subcategories of bettors learn?