

Risk-lovers in Periwigs

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Motivation

- ▶ Modelling attitudes toward risk is fundamental in decision theory
 - ▶ empirical measurement is difficult
 - ▶ experiments involve low stakes
 - ▶ people both gamble and buy insurance
- ▶ Explaining asset prices in terms of the pay-offs is fundamental in finance
 - ▶ clean characterization of the pay-offs is difficult
- ▶ if only we had:
 - ▶ a market populated with real investors putting serious money
 - ▶ assets with perfectly known pay-offs
 - ▶ sufficient variation in pay-off characteristics
 - ▶ observations on equilibrium prices of these assets

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 - ▶ observations on equilibrium prices of these assets
- ▶ or maybe we do . . .

1. Introduction
2. Lottery Loans in English and British public finance
3. Analysis of the prices

Lottery Loans

- ▶ gambling has been around forever
- ▶ sale of lotteries by governments to raise funds:
 - ▶ begins in 15th c. Flemish cities
 - ▶ spreads in 16th c. to Italy
 - ▶ arrives in late 17th c. in northern Europe
- ▶ England began issuing lottery loans in 1694
- ▶ lottery loans were very common in 18th c. Europe

Lottery Loans in Britain

- ▶ first loan issued in 1694, a second one (unsuccessful) in 1697
- ▶ England began issuing lottery loans in 1694
- ▶ Britain started again in 1710, continued to do so until 1768
- ▶ they formed a sizeable share of government loans (40% during the War of Spanish Succession, 1703–14)
- ▶ the State Lottery continued until 1826, but as a cash lottery

Share of lottery loans in debt funding

Period	Increases in funded debt (£)		
	Total	Lottery loans	(%)
1694–1700	8,380,230	1,000,000	11.9
1703–15	37,448,102	10,500,000	28.0
1719–26	19,429,220	4,911,990	25.3
1742–51	31,489,272	4,672,727	14.8
1755–68	64,095,553	6,042,256	9.4

Characteristics of the loans

- ▶ tickets sold for cash (except in 1748, 1759–68 when bundled with sale of annuities)
- ▶ ticket price was usually £10 (sometimes £100, sometimes £5 or £3)
- ▶ a draw took place that determined the size of the bond for each ticket
- ▶ the bonds were ex-post identical (except for size)
 - ▶ in 1694 and 1710, bonds paid off a constant annuity for 16 or 32 years
 - ▶ from 1711 to 1719, they paid off a fixed coupon + redemption within 32 years (timing determined by a second draw)
 - ▶ from 1721, they were perpetual (but redeemable) annuities (consols)
 - ▶ those of 1721–24 were redeemed soon after, those of 1726 and after were long-lived



the Drawing of the Lottery (1739)



Characteristics of Lotteries (1694–1743)

Year	Size (£m)	cost (%)	Authority	Royal assent	ticket price (£)	draw	benefits
1694	1.00	11.57	5 W & M, c. 7	2 Apr 1694	10	8 Oct - 5 Dec	16-year annuities
1697	1.40	4.06	8 & 9 Will. 3, c. 22	16 Apr 1697	10	10 Aug - 17 Aug	4% annuities, no term
1710	1.50	8.30	8 Anne, c. 4	18 Jan 1710	10	26 Jul - 26 Sep	32-year annuities
1711	1.50	8.39	9 Anne, c. 6	6 March 1711	10	2 Oct - 8 Jan	6%, reimbursed in 32 years
1711 (*)	2.00	8.68	9 Anne, c. 23	12 June 1711	100	1 Aug - 15 Aug	6%, reimbursed in 32 years
1712	1.80	8.62	10 Anne, c. 19	22 May 1712	10	20 Nov - 22 Jan	6%, reimbursed in 32 years
1712 (*)	1.80	8.62	10 Anne, c. 26	21 June 1712	100	30 Sep - 16 Oct	6%, reimbursed in 32 years
1713	0.50	5.95	12 Anne, st. 1, c 11	13 Oct 1713	10	11 Jan - 13 Feb	4%, reimbursed in 32 years
1714	1.40	6.52	12 Anne, st. 2 c. 9	9 Jul 1714	10	3 Jan - 4 Apr	4 or 5%, reimbursed in 32 years
1719	0.51	3.95	5 Geo 1, c. 3	18 Feb 1719	3	21 Sep - 31 Dec	4% redeemable annuities
1719	0.51	4.71	5 Geo. 1, c. 9	10 Mar 1719	3	21 Sep - 31 Dec	4% redeemable annuities
1721	0.70	4.00	7 Geo. 1, st. 1 c. 20	24 Jun 1721	10	2 Oct - 10 Nov	4% redeemable annuities
1722	0.70	4.00	8 Geo. 1, c. 2	12 Feb 1722	10	2 Jul - 9 Aug	4% redeemable annuities
1723	0.75	3.00	9 Geo. 1, c. 3	31 Jan 1723	10	17 Jun - 29 Jul	3% redeemable annuities
1724	0.75	3.00	10 Geo. 1, c. 2	19 Mar 1724	10	17 Aug - 1 Oct	3% redeemable annuities
1726	1.00	3.00	12 Geo. 1, c. 2	24 Feb 1726	10	19 Sep - 16 Nov	3% redeemable annuities
1731	0.80	3.00	4 Geo. 2, c. 9	7 May 1731	10	11 Oct - 25 Nov	3% redeemable annuities
1743	0.80	3.00	16 Geo. 2, c. 13	22 Mar 1743	10	21 Nov - 5 Jan	3% redeemable annuities

Characteristics of Lotteries (1644–1768)

Year	Size (£m)	cost (%)	Authority	Royal assent	ticket price (£)	draw	benefits
1744	0.60	3.00	17 Geo. 2, c. 18	22 Mar 1744	10	26 Nov - 3 Jan	3% redeemable annuities
1745	0.50	3.00	18 Geo. 2, c. 9	19 Mar 1745	10	25 Nov - 28 Dec	3% redeemable annuities
1746	0.50	4.00	19 Geo 2 c. 12	19 Mar 1746	10	24 Nov - 26 Dec	4% redeemable annuities
1747	1.00	4.00	20 Geo 2 c. 10	24 Mar 1747	10	23 Nov - 24 Dec	4% redeemable annuities
1748	0.57**	4.00	21 Geo. 2, c. 2	18 Feb 1748	10	12 Sep - 22 Oct	4% redeemable annuities
1751	0.70	3.00	24 Geo 2 c. 2	12 Mar 1751	10	11 Nov - 24 Dec	3% redeemable annuities
1755	1.00	3.00	28 Geo 2 c. 15	25 Apr 1755	10	6 Oct - 1 Nov	3% 1752 consols
1756	0.50	3.00	29 Geo 2 c. 7	9 Mar 1756	10	22 Nov - 23 Dec	3% 1752 consols
1758	0.50	3.00	31 Geo 2 c. 22	9 Jun 1758	10	13 Nov - 14 Dec	3% 1752 consols
1759	0.57**	3.00	32 Geo 2 c. 10	5 Apr 1759	10	13 Nov - 22 Dec	3% 1759 annuities
1760	0.23**	***	33 Geo 2 c. 7	4 Feb 1760	3	17 Nov - 13 Dec	4%–3% 1760 annuities
1761	0.60**	3.00	1 Geo 3 c. 7	20 Jan 1761	10	16 Nov - 24 Dec	3% 1752 consols
1763	0.29**	4.00	3 Geo 3 c. 12	31 Mar 1763	10	30 May - 21 Jun	4% 1763 annuities
1763	0.29**	4.00	3 Geo 3 c. 12	31 Mar 1763	10	28 Nov - 20 Dec	4% 1763 annuities
1765	0.25**	3.00	5 Geo 3 c. 23	10 May 1765	10	18 Nov - 24 Dec	3% 1752 consols
1766	0.60**	3.00	6 Geo 3 c. 39	6 Jun 1766	10	17 Nov - 24 Dec	3% 1752 consols
1767	0.60**	3.00	7 Geo 3 c. 24	20 May 1767	10	16 Nov - 15 Jan	3% 1752 consols
1768	0.60**	3.00	8 Geo 3 c. 31	8 Mar 1768	10	14 Nov - 3 Jan	3% 1752 consols



Probability distribution of prizes (1)

	1694	1710	1711	1711 (classes)	1712	1712 (classes)	1713	1714	1719
20,000				5.0		5.6		0.7	0.6
12,000			0.7		1.7				
10,000	1.0	0.7					4.0	1.4	1.2
5,000	9.0	2.0	2.0	10.0	1.7	11.1	2.0	2.1	3.0
4,000		2.7	2.7	15.0	1.7	16.7	2.0	2.9	
3,000		2.7	2.7	20.0	3.3	22.2	2.0	3.6	
2,000		2.7	2.7	20.0	3.3	22.2	2.0	7.1	
1,500	1.0								
1,000	21.0	13.3	13.3	25.0	16.7	27.8	10.0	15.0	17.8
500	80.0	21.3	21.3	70.0	33.3	22.2	20.0	29.3	42.1
400				80.0		88.9			
300				100.0		111.1			
250	90.0								
200	300.0	66.7	66.7	3750.0	50.0	9405.6	40.0	71.4	
105									
to 130				99655.0		90266.7			
100	2000.0	400.7	166.7		166.7		100.0	357.1	239.5
50		1988.7	954.0		940.0		800.0	714.3	474.3
25									834.8
20			15434.0		15448.3		12982.0	16126.4	
10	97500.0		83333.3		83333.3		86036.0	82668.6	15053.5
8									
7		97500.0							
0									83333.2

	1721-2	1723-4	1726	1731	1743	1744	1745-7	1748
20,000			1.0					
10,000	1.4	1.3	2.0	2.5	2.5	3.3	4.0	4.8
5,000	2.9	2.7	2.0	5.0	5.0	6.7	6.0	6.3
3,000	2.9	2.7	3.0	2.5	2.5			
2,000	4.3	4.0	5.0	6.3	6.3	8.3	10.0	11.1
1,000	30.0	28.0	29.0	18.8	20.0	21.7	32.0	31.7
500	44.3	54.7	50.0	27.5	32.5	43.3	64.0	63.5
100	214.3	333.3	360.0	296.3	311.3	331.7	302.0	271.4
50	571.4	666.7			586.3	673.3	796.0	701.6
20	9128.6	8906.7	7550.0	9643.8	10773.8	15215.0	13090.0	12801.6
8	90000.0							
7.5		90000.0	91998.0	89997.5				
7					88260.0			
6						83696.7	85696.0	86107.9



Probability distribution of prizes (3)

	1751	1755	1756, 58	1759	1760	1761, 65, 66	1763	1767	1768
20,000				3.0				1.7	3.3
10,000	2.9	2.0	4.0		2.5	3.3	5.7	5.0	6.7
5,000	5.7	4.0	6.0	3.0	2.5	3.3	5.7	6.7	8.3
3,000	7.1			3.0					
2,000	11.4	6.0	12.0	3.0	5.0	6.7	11.4	16.7	16.7
1,000	30.0	32.0	36.0	39.4	17.5	18.3	31.4	31.7	35.0
500	60.0	42.0	60.0	47.0	27.5	35.0	80.0	71.7	68.3
100	285.7	198.0	284.0	227.3	125.0	166.7	357.1	333.3	333.3
50	600.0	4020.0	1252.0	1060.6	500.0	335.0	1514.3	1016.7	1000.0
20	13285.7		11350.0	12768.2	2500.0	19343.3	14571.4	34916.7	31958.3
6	85711.4	95696.0	86996.0	85845.5		80088.3			
5							83422.9		
0					83445.0			63600.0	66570.0

Winners

- ▶ Who invested in these lottery loans?
- ▶ we have a randomly drawn sample: the winners
- ▶ newspapers frequently reported particulars of the winners
 - ▶ the existence of many can be confirmed
 - ▶ some have left a trace in history

Winners (1694–1714)

1694 Lottery

- £1,000 Samuel de Ravenel (c1667-1731) and François Le Coq (d. 1719), French émigrés
- £500 Sir William Gore (Irish magistrate, d. 1700)
- Gibbs, stone-cutter and 3 others
- Proctor, stationer and Skinner, hosier

1710 Lottery

- £1,000 Thomas Barnaby, attorney
- £500 the lord Harvey (former MP, later earl of Bristol, 1655-1751)
- £400 Dunning, cheesemonger

1711 Lottery

- £12,000 Joseph Hodges (d. 1722), son of a merchant and politician

1711 Classes Lottery

- £20,000 Thomas Weddell (d. 1747), merchant of York and London
- £5,000 Samuel Strode (d. 1728), surgeon and Matthew Wymondesold (1677–1757), goldsmith
- £5,000 John Hunt, gentleman of Northants.

1712 Classes Lottery

- £20,000 Margaret Williams, widow
- £5,000 Theophilus Dillingham, woollen draper
- £5,000 John Mendes de Costa, merchant

1713 Lottery

- £10,000 Colonel Mathew

1714 Lottery

- 20,000 Rev. William Freind (c1669–1745)
 - 10,000 Rennerana, a French merchant in St Bartholomew Lane
 - Tovey, a Norwich factor, and Wm Trumsher, a hosier's apprentice
 - 5,000 attorney in Essex
 - brewer in the Seven Dials
 - Susanna Mountfort, actress (1690-1720)
 - 4,000 Mitford Crowe (former governor of the Barbados, 1669-1719)
 - 3,000 butler of the dean of Salisbury
 - Bridges, Esq
 - Thomas Caverley, dancing-master (d. 1745)
 - 2,000 mercer of Colchester
 - 1,000 orange-merchant near Billingsgate
 - Madam Mead's coachman
 - Rev. Gibbs, of Bristol
-

Winners (1719)

1719 Lottery

20,000	Moses Hart (1675–1756) and Isaac Franks (d. 1736) Mr Cox, a merchant in Berry-St
10,000	a poor clothier in Newberry with ten children John Rudge (1669–1740), merchant, MP, director of the Bank
5,000	Mr Warren in Theobald's Row, by Red-Lion Square Mr Owen, a clerk in the East India House John Lloyd (d. 1737), Blackwell-Hall factor (cloth merchant) Mr Narsh George Wanley (d. 1729), goldsmith Job Matthews, apothecary a merchant in this city a cow-keeper in Islington Revd Mr Morris, of Abergavenny in Monmouthshire
1,000	an in-keeper in St Martin in the Fields one of the Lord Mayor's officers [Thomas] Nash, upholsterer Robert Heysham (1663–1723), MP for London [Thomas] Snow (d. 1748), partner with [John] Warner (d. 1722), goldsmiths Arthur Cutting and Thomas Hyeth, cheesemongers [William] Jenkins, deputy [of Billingsgate ward] Jenkinson, cheesemonger in Thames Street [James] Colebrooke and Ruck [Rooke], bankers [Robert] Spark[e] (d. 1728), ironmonger (to HM), Catherine-St in the Strand Philip Gibbs (d. 1752), Backwell-Hall Factor (cloth merchant) Henry O'Brien, earl of Thomond (d. 1741) a gentlewoman unknown
500	the share of Mr Martin and Company, goldsmiths in Lombard St. George Wanley, goldsmith (d. 1729) Dr. John Freind, physician (1675–1728) a vintner at the Crown, by Guildhall Glisson Maydwell (d. 1748), glass-seller David Milne, a great insurer of ships Mr Jenkins, cheesemonger in Thames St and an orange-merchant's apprentice

Winners (1721–43)

1721 lottery

10,000 John Bennet (1683-1739), master in chancery

5,000 a French merchant in Mincing-Lane

5,000 a mercer

1722 Lottery

10,000 the countess of Darlington (1675-1725)

5,000 Soulier, French merchant near the royal exchange

5,000 the house-keeper, butler and footman of Mr Windham, a linen draper in Cornhill

1723 Lottery

10,000 Mr. Bernard, a shopkeeper in Southampton

5,000 Sir John Lambert (1666-1723), late director of the South Sea Co

5,000

1724 Lottery

10,000 Henry Pelham (1694-1754), gave it to Dr Bradshaw, a Sussex clergyman, his former tutor

5,000 Major Mason, of Downing Street

5,000

1726 Lottery

20,000 John Goodwyn (1672-1763), surgeon, alderman of King's Lynn

10,000 Anthony Duncombe (1695–1763), MP, nephew of Charles Duncombe, banker

10,000 Thomas Brian (+1749), custom-house officer, son of the Harrow headmaster

5,000 Mr Gladwin and Mr. Williams, brokers

5,000

1731 Lottery

10,000 Thomas Walker (c1664-1748), HM Commissioner of Customs

10,000 John Bance (c1694-1755), merchant, director of East-India Co (later Bank director, MP)

5,000 Mr Van Eck, Dutch merchant in Threadneedle St

5,000 a goldsmith in Lombard St

5,000 Mr Heathcote, nephew to Sir Gilbert Heathcote (1652–1733, the richest commoner in England)

5,000 John Garway, hop-merchant in Worcester

1743 Lottery

10,000 Eldridge, draughtsman in the shipyards at Deptford

10,000 the master of a pub in Greenwich

5,000 Mrs. [Mary] Shuckburgh, widow [of a stationer] in Stoke Newington

5,000 John Julian (d. 1754), merchant [from Berne]

5,000 a French clergyman in the City

5,000

Winners

- ▶ Thomas Weddell (1712): merchant from York, cousin of Ch. of the Exchequer John Aislabie, paymaster of the Navy, made a fortune in the South Sea and left £70,000
- ▶ Matthew Wymondesold (1712): Aislabie's broker
- ▶ Samuel Strode (1712): bought a manor, his son became MP
- ▶ John Hodges (1711): son of a director of the Bank of England and MP
- ▶ top prize in 1719: two German Jews (a merchant and a stockbroker); the former's daughter married the latter and brought 1/2 of the ticket as dowry; Franks also won a large prize in a Dutch lottery
- ▶ John Rudge (1719): director of the Bank of England
- ▶ John Wanley: goldsmith and banker, his daughter married a South Sea director and was worth £30,000
- ▶ John Goodwyn (1726): later mayor of King's Lynn, had his portrait painted holding the ticket



Unlucky Winners

- ▶ Susanna Mountfort (1714): daughter of actors and an actress, went mad soon after
- ▶ top prize in 1714: Rev. William Freind, a clergyman who died 30 years later in debtor's prison
- ▶ John Garway (1731): prominent Worcester merchant, went bankrupt in 1749
- ▶ John Julian (1743): died in 1754, his son went bankrupt
- ▶ Sir Charles Armand Pawlett (1751): died the day his ticket was drawn!



Social Table of England and Wales, 1688

	Families	
	number	income (£)
Temporal lords	200	6060
Baronets	800	1500
Spiritual lords	26	1300
Knights	600	800
Esquires	3,000	562.5
Greater merchants	5,264	400
Gentlemen	15,000	280
Persons in offices, greater	5,000	240
Lesser merchants, artisans and handicrafts	27,802	200
Persons in the Law	8,062	154
Persons in offices, lesser	5,000	120
Freeholders, greater	27,568	91
Naval officers	5,000	80
Clergymen, greater	2,000	72
Persons in sciences and liberal arts, military officers	16,898	60
Freeholders, lesser	96,490	55
Clergymen, lesser	10,000	50
Shopkeepers and tradesmen	101,704	45
Farmers	103,382	42.5
Manufacturing trades	162,863	38
Building trades	73,018	25
Common seamen	50,000	20
Laboring people and outservants, miners	299,237	15
Common soldiers	35,000	14
Cottagers and paupers	313,183	6.5
vagrants	23,489	2
All Families	1,390,586	39.1



Who could and who did invest?

- ▶ median household income: £20 (1688) to £25 (1759)
- ▶ average household income: £39 (1688) to £45 (1759)
 - ▶ a £100 ticket was a substantial expenditure
- ▶ winners are overwhelmingly from the above-median categories
- ▶ many are tradesmen, merchants, bankers (presumably rational people...)



Markets



Information

- ▶ published Acts of Parliament contained details of prizes
- ▶ newspapers reported every day on the current draw
- ▶ private services were available to provide up-to-date news

Information

At North's Coffee-house in King-street by Guild-hall.

All that are desirous to know what Tickers are drawn may know every Quarter of an Hour. Likewise may know from the Beginning, (I having a better Opportunity than any other :) If you please to come you may be satisfy'd. Where likewise you may have a Collection of all the Prizes drawn that Day by 4 of the Clock.

At the Queen's-street Coffee-house in Westminster, the Blanks and Prizes drawn in the Million and half Lottery may be seen every Hour as they are drawn.

All Persons concern'd in the Publick Lottery may immediately be Reflv'd how many of their Tickets are drawn, and whether Prizes or Blanks, (always to the present Hour, by the most correct and certain Method, having all the Numbers from the first drawn duely examin'd and Posted up, which none else pretends to,) and those who send or leave their Numbers shall have Notice sent them either in Town or Country of their Prizes as soon as drawn, without further Trouble, and as Reasonably as can be desir'd, at the Grand Lottery Office at the White-Lyon in King's-street near Guild-Hall. By Nath. Symms.

A very fine new Chariot never wore, very finely Painted, &c. and a Blank left to put in a Coat of Arms, and lined with a fine Coffoy, with Iron Axletrees, &c. and a Pair of fine new Rumpce Town-Harness, to be sold a Pennyworth, at a Coach-Maker's in Sun-yard in Bishopsgate-street.

1710 lottery



Information

London, August 14.

A Continuation of the Account of the Lottery now Drawing at Guildhall, to Saturday last Inclusive.

	Number of Tickets Drawn.	Number of the Benefits.	Value of the Benefits per Annum.
Total 2d Week.	18732	474	4735 l.
11th Day. Aug. 7.	2381	73	570
12th 8.	2408	67	420
13th 9.	2430	67	1410
14th 10.	2411	76	545
15th 11.	2481	61	715
16th 12.	2649	63	1170
Total 3d Week.	33492	881	9565 l.

As 150000, the Number of the Tickets in the Lottery, is to 3750, the whole Number of the Benefits; So is 33492, the Number of the Tickets drawn, to 837: But the Number of the Benefits drawn being 881, therefore there are 44 more Benefits drawn, than the exact Proportion of 19. Blanks to 1. Benefit.

By the same Rule it will be found, that about 2280 l. per Annum hath been drawn in Benefits, more than an exact Proportion.

	Drawn.	Not Drawn.	Total.
Benefits of 1000 l. per Annum	1	0	1
500	1	2	3
400	3	1	4
300	2	2	4
200	1	3	4
100	4	16	20
50	5	27	32
20	28	72	100
10	135	466	601
5	701	2282	2983
	881	2871	3752 *

* Including in those Numbers, the first and last Drawn Tickets.

1710 lottery



Information

Advertisements.

WHEREAS *Matthew West*, at the *Seven Stars* in *Clare-street* in *Clare-market* Goldsmith, did, in the two last Lotteries, purchase above 200 Tickets, which he dispos'd of, by dividing each Ticket into 20 equal Shares, and thereby gave entire Satisfaction to the Persons concern'd therein; this is to give Notice, That he has purchas'd a considerable Number of Tickets in her Majesty's ensuing Lottery for the Year 1715, that those who are willing, may become Joint-Sharers in the said Tickets, viz.

A TABLE of her Majesty's Royal Lottery, being but about six Blanks to one Prize.

		l.	l.
2	—of—	10000	20000
1	—	5000	5000
1	—	4000	4000
1	—	3000	3000
1	—	2000	2000
5	—	1000	5000
10	—	500	5000
20	—	200	4000
50	—	100	5000
400	—	50	20000
6491	—	20	120820
6982	Total Benefits.	202820	
43018	— 10	430180	
50000	Benef. & Blanks.	633000	

Any Person paying 11 s.

6d. will be entitled to one twentieth Part of a Ticket, for 1 l. 3 s. to a tenth Part; for 2 l. 6 s. a fifth Part, and for 2 l. 17 s. 6 d. will be entitled to one fourth Part of a Ticket. As for those who have a Mind to try their Chance in a greater Number of Tickets, they may for 11 l. 10 s. have a twentieth Part of twenty several Tickets; and for 57 l. 10 s. have the same Share of 100 Tickets; which Money will buy but five whole Tickets. It is evident, that those who are not able to purchase one whole Ticket in the Lottery, may, by this Method, for so small a Charge as before express'd, purchase an equal Chance according to the respective Shares they are dispos'd to purchase; and likewise those who put in a considerable Sum, will be intitled to a greater Number of Chances, than by purchasing such a Number of Tickets as that Sum would amount to; and the Chance of each Adventurer is likewise spread into a greater Latitude. The Loss in the Blanks cannot be above 4 d. in each Share-Ticket, of what they are sold for on the Exchange; but if a Prize, the Gain by one Share-Ticket may be from 20 to 40, 50, 100, 200, 300, 400 Pounds, or more. And within two Months after the Lottery is drawn, the Tickets shall be sold, whether Blanks or Prizes, at the best Market-Price on the Exchange; of which, Notice shall be given in the News-Papers, that any of the Sharers may be present at the Sale; and within one Month after the Sale, each Person may receive their respective Shares at the said *Matthew West's* House, deducting 5 l. per Cent. for Charge and Trouble. Receipts or Share-Tickets are to be had of Mr. Curll, Bookseller, at the Dial and Bible against St. Dunstan's Church, Fleet-street; Mr. Jones at North's Coffee-house in King-street, by Guild-Hall; Mr. Edling the Corner of St. Mary Ax in Leadenhall-street; Mr. Jones, at the Wooll-pack in Foster-lane; Mr. Ellis, Goldsmith, at the seven Stars in Fleet-street; and of the aforesaid *Matthew West*, the said Royal Lottery Tickets being now in his Hands; who also buys and sells whole Tickets.

Information

Matthew West gives Notice, that now the Holland Lottery is all drawn, come over, and compleated, those Persons that have Prizes in the Shares with him, may exchange them for Shares of Tickets in the present Lottery, for he continues to cut out Shares of undrawn Tickets all the drawing of the Lottery, or have Money for the same, at his House in Clare-streer, Clare-market, or at North's Coffee-house, in King-street; near Guild-hall, where the said Matt. West keeps exact Numerical-Books, by which any Person may know whether their Numbers are drawn Blank or Prize, either in the Dutch or English Lotteries; and likewise have their Tickets Register'd at 6d. per Ticket, and an immediate Account sent them to the Place of their Abode, when their Numbers arise, whether Blank or Prize, or enter their Numbers gratis, paying only 2 s. 6 d. for each Prize. ☞ The said Matthew West buys Prizes of whole Tickets in the Dutch, and Blanks and Prizes in the English Lottery now drawing.

Jan 1715



Intermediation

- ▶ 1711: Smyth and Collier offer $\frac{1}{20}$ tickets at 5.25% premium to buy a pool of 2,000 tickets
- ▶ Matthew West (goldsmith) offered schemes repeatedly through the 1710s
- ▶ riding a horse:
 - ▶ “the term Horse is technical for the chance of a number for a certain time, upon condition (if it draws a prize) or replacing it to the vendor with an undrawn ticket” (1726)
 - ▶ made illegal in 1737



Intermediation

Tickets in the present Lottery for 500000 l. cut out at the Blue Leg in Bow-Lane. A Person by paying only 4 s. may be entituled to the 20th part of a Ticket, and gain thereby from 10 s. to 1000 l. The highest Prize is 20000 l. and but 5 Blanks to one Prize; the Tickets will speedily advance in Value: Therefore those Persons who design to take any Shares, are desired to be speedy. A Person for paying 20 s. will be entituled to a 20th part of the Prizes in 10 Tickets; and for 4 l. to a 20th part of the Prizes in 20 several Tickets; and so in proportion to any Sum and Number of Tickets.

1719 lottery (£3 tickets)

Intermediation

* * At Bucks Wharfe in the Bridge-Yard in South-wark, good Devonshire Cyder to be Sold by Henry Collier; note, he is the Maker, and can render it Cheaper than any Retailer.

* * *Matthew West, Goldsmith, at the Seven Stars, in Clare Street, Clare Market, gives Notice, that notwithstanding the Royal Tickets in the English Lottery of 500,000 l. are not yet delivered out, he Disposes of Receipts for Shares in the said Lottery, a eighth part, a quarter part of a Ticket, for which he gives a Printed Receipt, which said Receipt must be brought to his House to have the Number of the Royal Ticket inserted, when the Original Tickets are delivered out at his House aforesaid, and at Norton's Coffee-House in Kings Street near Guild-hall at the following Price, viz. for 9s. you may have a eighth part of a Ticket, and for 18 s. a quarter part, and so on for as may as you please; you may gain for 9 s. 100, 300, 500, 1000 or 2000 l. or upwards, besides many other valuable Prizes, as may be seen in the Scheme at large. Note, for 9l. any Person may have 20 several Tickets, and for 22 l. 10 s. will have a eighth part of 50 Tickets, and for 45 l. may have a eighth part of a 100 several Tickets, so that the Purchasers thereof spreads themselves into a greater Latitude. N. B. Likewise Disposes of Shares and whole Tickets in the Dutch and Utrecht Lotteries, which will begin Drawing the next Month.*

A More perfect, speedy, cheap, and private Cure for all Degrees of the *Secret Disease*, than ever was made known before to Mankind. This *Arcanum* is an Internal Balsam of Life, and seems to be a Gift sent from God, to relieve the Distress'd of both Sexes. It is to great a Treasure in Medicine, as exceeds all Estimation, for it passeth thro' the whole Body like Fire, and consumes all Symptoms of the *French Disease*, as Fire burns Wood, or as the Sun dries up Water exorcising all Malignity, and noxious Humours out of the

Intermediation

At the Lottery-Office, in a Cabinet-Shop, within 3 Doors of the Rainbow Coffee-House on Ludgate Hill.

TICKETS and Shares of Tickets in the present Holland and Urrecht Lotterys are Sold at Reasonable Rates, where are kept Correct Numerical Books for the Royal English, and all Foreign Lotterys, by the Person that Posted all the Lottery Books at the Crown Coffee-House behind the Royal Exchange, and invented the method of directing to the List, Page and Column in which each Number is to be found (to the general satisfaction of all Persons concern'd) who will continue the same Method for all Foreign Lotterys, and is preparing Books for Posting the Royal English Lotterys, in such a Method as to tell at sight, in what Month, day of the Month, and hour of the Day each Number is drawn, which will be very convenient for all Persons that Buy or Sell undrawn Tickets during the Time the Lotterys are drawing. He will also sell Tickets and Shares of Tickets in the said Lotterys, so soon as the same are deliver'd out. At the said Office are likewise prepar'd Register Books for such Persons as are inclin'd to Enter their Numbers in either or all the said Lotterys, who will have an immediate Account sent them of their Success, eithe in Town or any other part of Great Britain. At 6 d. per Ticket, and if in Shares at 3 d. per Share.

Ruptures cured by William Collier at the Sign of the Bell and Naked Boy in St. John's-lane, alias St. James's-lane, near

Mar 1719



Henry Fielding's "The Lottery"

Coachman. Oh Sir! your worship has let me a very lucky horse: it is come up twenty pound already. So if your worship would let me have the money—

Stocks. Let me see, tickets are this day nineteen pound; and your prize is worth eighteen pound eighteen shillings; so if you give me two shillings, which are the difference, we shall be quit.

Coachman. How, Sir! how!

Stocks. Upon my word, friend, I state the account right.

Coachman. Oh,—the devil! and have I given three pound for the chance of losing two shillings more?

Stocks. Alas, Sir! I cannot help ill fortune.—You have had ill luck; it might have come up a hundred, or a thousand, or ten thousand.



“horses”

The Ticket N^o 68221, which was last Monday drawn a Prize of 1000 l. at Guildhall, was what the merry Gentlemen of Exchange Alley call a Horse, which was let to a Person for a few Shillings by Mr. Dove in Exchange Alley. The lucky Adventurer the next Day sold the Prize, and receiv'd the Money for it; and in Consideration of his good Fortune, entertain'd most of his Friends very handsomely that Evening. We are inform'd that such a prodigious Number of Prizes in this Lottery have fell to the Share of such Adventurers, that Multitudes of People daily hire these Horses, and chuse rather to lay out their Money this Way than in buying Tickets.

“horses”

“ Last Friday, 2 Prizes of 1000l. each, came up in the *State Lottery*, one whereof was fold by the Son of Mr. *Shancks*, who keeps Nando's Coffee-Houfe by *Temple-Bar*, and let out to 3 tricklayers, who club'd Ten Groats each to make Ten Shillings among them. The said Horse was fold for 940l. ready *Money*.

“horses”

Yesterday a Prize of one Hundred Pounds came up, and fell to a Jew who hired that Ticket for that Day for half a Crown.

Yesterday were recall'd at the Box Office.

John Law's insurance (Holland, 1713)

In a Dutch lottery, Law offered:

- ▶ insure 10 tickets against all coming out blank
- ▶ insure 100 tickets to return a minimum 25%, return in excess split with him

prob (%)	pay-off net of ticket price	
	uninsured	insured
0.4	6277	651
7.7	143	-108
91.8	-43	-3

Lottery Insurance, 1719

Mercers Hall; Aug. 26, 1719.
 The Subscribers to the Fund of 120,000 l. having this Day completed their Subscription for insuring the Proprietors of the Tickets in the Government Lotteries, from Part of the Loss to which they are at present liable, will be ready to receive the said Tickets at their Office at Mercers Hall, on Thursday the 3d. of September next; so that any Person or Persons who are possessor of Tickets in either or both the said Lotteries, may be insured by them on the following Terms, viz: For every 96 Tickets insured, the Proprietors agreeing to allow to the Company, after the said Tickets shall be drawn, 76 l. 16 s. which is only 16 s. per Ticket; and 5 per Cent. on the Prizes that shall arise on the said Tickets, the Company will make up the said Tickets, whether they be Blanks, Prizes, or both, 288 l. being 3 l. for each Ticket, valuing the Prizes at Par. For every 48 Tickets, the Proprietors agreeing to allow 45 l. 12 s. which is 19 s. per Ticket, and 5 per Cent. on the Prizes as above, the Company will make up the said Tickets 144 l. For every 24 Tickets, the Proprietors agreeing to allow 26 l. 8 s. being 1 l. 2 s. per Ticket, and 5 per Cent. on the Prizes, as above, the Company will make up the said Tickets 72 l. And for every 12 Tickets, the Proprietors agreeing to allow 15 l. which is 1 l. 5 s. per Ticket, and 5 per Cent. on the Prizes, the Company will make up the said Tickets 36 l. The Proprietors of the Tickets are to advance no Money for this Security, but when drawn to allow as above; the Tickets are to be left in the Company's Hands till drawn, for which they will have Receipts, mentioning what Lottery they are in, the Number on each Ticket, and Conditions of the Assurance; the Company being answerable to the Bearer of such Receipts for the said Tickets, they will be in all Respects as useful as if in their own Hands. N.B. The Tickets are to be sealed up by the Proprietors, with their Names indorsed thereon, and secured in the Bank of England. If the said Tickets are not called for by the Proprietors within 90 Days after they shall be drawn, the Tickets and Prizes to be the Company's.



Lottery Insurance, 1719 (2)

The 1719 lottery was cheaper (£3) but the blanks (83.3%) paid nothing.
Two insurance schemes proposed:

- ▶ insure 25–49 tickets for £1.25/ticket, > 50 tickets for £1.125/ticket, and pay £3 per blank
- ▶ insure sets of n , 12, 24, 48, 96 at variable premium and pay the insured $\max\{0, 3n - v\}$ where v is the value of the set; for a 5% share of v the premium can be lowered

size of set	96	48	24	12
premium (£/ticket)				
with 5%: p_1	0.8	0.95	1.1	1.25
without: p_2	0.9	1.05	1.2	1.375
insurer's expected profit per ticket				
with 5%: $p_1 - E(\max\{0, 3n - v\}/n) + E(.05v v > 3n)/n$	0.60	0.40	0.31	0.30
without: $p_2 - E(\max\{0, 3n - v\}/n)$	0.57	0.34	0.16	0.10

More derivatives

Lottery Million	
All or Any	3 l. 8 s.
All or None	3 l. 0 s.
Blank	7 l. 0 s.
Put	2 l. 15 s.
Refuse	3 l. 6 s.

Secondary markets

Yesterday South-Sea Stock was 104 3 8ths, 104 1 half. South-Sea Annuity 100. India 147 1 4th. Bank 127 1 4th. African 10. York-Buildings 13, to 13 1 4th. Royal Assurance 80, 80 1 half. London Assurance 11 1 8th. South-Sea Bonds 36 s. India Bonds 43 s. Tickets 9 l. 11 s. 6 d. Chances for this Day 3 s.

Secondary markets (2)

- ▶ "The price of tickets in the wheel advance, and stock jobbers lay wagers that they will advance to £10 a piece before the drawing is finished" (*Weekly Journal* 10 Oct 1719, issue 46).
- ▶ "Our lottery tickets sold yesterday [Oct 30] at 41 above par and continue rising; 'tis occasion'd by the great numbers of blanks already drawn, more than in proportion to the prizes" (*Weekly Packet*, 31 Oct 1719, issue 382).
- ▶ "The highest prize in the wheel is £1000, which occasioned the fall of the tickets about 6s apiece, but they rise again now, being something above par" (*Weekly Journal* 28 Nov 1719, issue 52).
- ▶ "Our stock-jobbers have run up the prize of undrawn lottery tickets to a very great height, and they work them up 30 or 40s a piece per diem; they were yesterday at 8 guineas, and we hear some considerable wagers are laid, that they will be £50 a piece before the lottery is done drawing" (*Weekly Journal* 19 Dec 1719, issue 55).
- ▶ "On Tuesday last was drawn number 151,028 which came up £1000, which occasion'd a considerable fall of undrawn tickets" (*Original Weekly Journal*, 26 Dec 1719).
- ▶ "On Saturday the number 108,125 came up £1000, which was the last in the wheel; notwithstanding which the undrawn tickets continue to rise, and 'tis said that in the last hour of drawing they will be worth at least £50 a piece" (*Daily Post*, 29 Dec 1719, issue 75).
- ▶ "On Wednesday night undrawn lottery tickets were at £20 which was offer'd by a gentleman who wanted a hundred, but this morning they fell to £18" (*Weekly Packet* 2 Jan 1720, issue 391).

The Data

- ▶ collection of 25 lotteries (1710–68)
- ▶ the draw of each lottery took 4–6 weeks
- ▶ during the draw, newspapers and other sources provide:
 - ▶ the prizes drawn to date
 - ▶ current market prices of undrawn tickets (and, after a few days, blanks)
- ▶ prizes are really bonds, so I need its market value
 - ▶ blanks when they are available
 - ▶ the same or similar bond (easy after 1726)

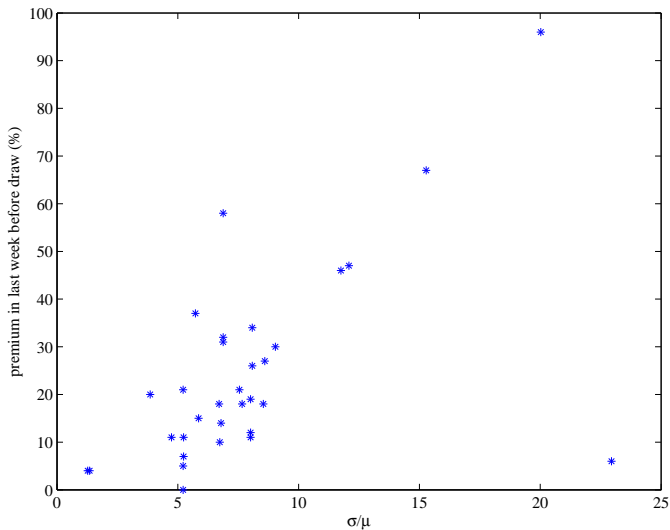


Financial characteristics of the loans

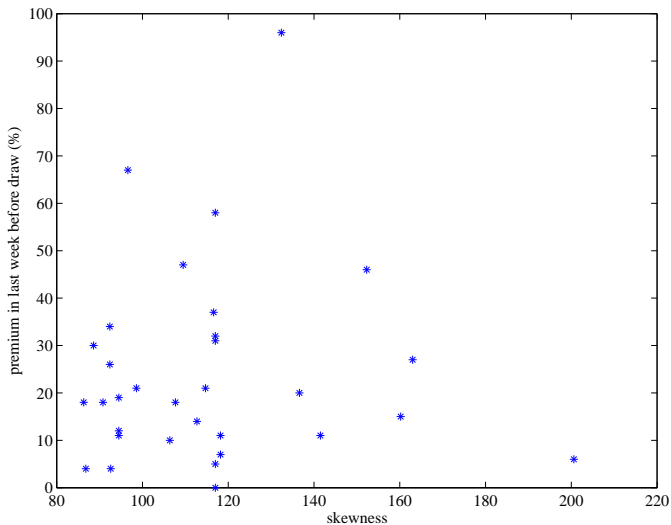
Lottery	ticket price	mean pay-off	lowest /mean	% blanks	std	σ/μ	skew	1st 2 weeks		last week	
								mkt price	premium	mkt price	premium
1694	10	13.75	0.73	0.98	63.0	4.58	86.0	10	0.12		
1710	10	9.00	0.78	0.98	47.0	5.22	114.7	1.10	0.22	1.09	0.21
1711	10	12.86	0.78	0.83	49.7	3.86	136.6	1.04	0.15	1.08	0.20
1711 (cl)	100	130.11	0.85	0.96	165.4	1.27	92.6	10.08	0.08	9.71	0.04
1712	10	13.01	0.77	0.83	61.7	4.74	141.5	1.08	0.16	1.04	0.11
1712 (cl)	100	130.10	0.81	0.90	175.0	1.35	86.8	10.37	0.11	9.71	0.04
1713	10	12.66	0.79	0.86	72.5	5.73	116.6	0.96	0.37	0.96	0.37
1714	10	13.40	0.75	0.83	78.5	5.86	160.2	0.94	0.13	0.96	0.15
1719	3	2.96	0.00	0.83	68.0	22.95	200.6	3.50	0.18	3.15	0.06
1721	10	10.50	0.76	0.90	54.8	5.22	117.0	10.82	0.03	10.49	0.00
1722	10	10.50	0.76	0.90	54.8	5.22	117.0	11.42	0.09	11.06	0.05
1723	10	10.18	0.74	0.90	53.4	5.24	118.2	10.68	0.05	10.91	0.07
1724	10	10.18	0.74	0.90	53.4	5.24	118.2	10.93	0.07	11.34	0.11
1726	10	10.00	0.75	0.92	86.0	8.60	163.0	13.90	0.39	12.68	0.27
1731	10	10.00	0.75	0.90	67.1	6.71	107.7	10.74	0.07	11.77	0.18
1743	10	10.00	0.70	0.88	67.4	6.74	106.4	11.13	0.11	11.02	0.10
1744	10	10.00	0.60	0.84	75.5	7.55	98.6	11.95	0.19	12.06	0.21
1745	10	10.00	0.60	0.86	80.1	8.01	94.5	12.57	0.26	11.93	0.19
1746	10	10.00	0.60	0.86	80.1	8.01	94.5	11.54	0.15	11.18	0.12
1747	10	10.00	0.60	0.86	80.1	8.01	94.5	10.93	0.09	11.11	0.11
1748	10	10.00	0.60	0.86	85.4	8.54	90.8	11.32	0.13	11.84	0.18
1751	10	10.00	0.60	0.86	76.6	7.66	86.3	11.51	0.15	11.76	0.18
1755	10	9.00	0.67	0.96	61.1	6.79	112.7	10.01	0.11	10.29	0.14
1756	10	10.00	0.60	0.87	80.8	8.08	92.4	13.14	0.31	13.45	0.34
1758	10	10.00	0.60	0.87	80.8	8.08	92.4	11.45	0.15	12.55	0.26
1759	10	10.00	0.60	0.86	117.5	11.75	152.3	13.51	0.35	14.65	0.46
1760	3	3.00	0.00	0.83	60.1	20.02	132.4	5.37	0.79	5.89	0.96
1761	10	10.00	0.60	0.80	68.8	6.88	117.0	14.85	0.48	15.77	0.58
1763	10	10.00	0.50	0.83	90.4	9.04	88.6	14.07	0.41	12.99	0.30
1765	10	10.00	0.60	0.80	68.8	6.88	117.0	13.85	0.38	13.18	0.32
1766	10	10.00	0.60	0.80	68.8	6.88	117.0	13.47	0.35	13.11	0.31
1767	10	10.00	0.00	0.64	120.8	12.08	109.5	14.31	0.43	14.70	0.47
1768	10	10.00	0.00	0.67	152.8	15.28	96.6	16.45	0.64	16.74	0.67



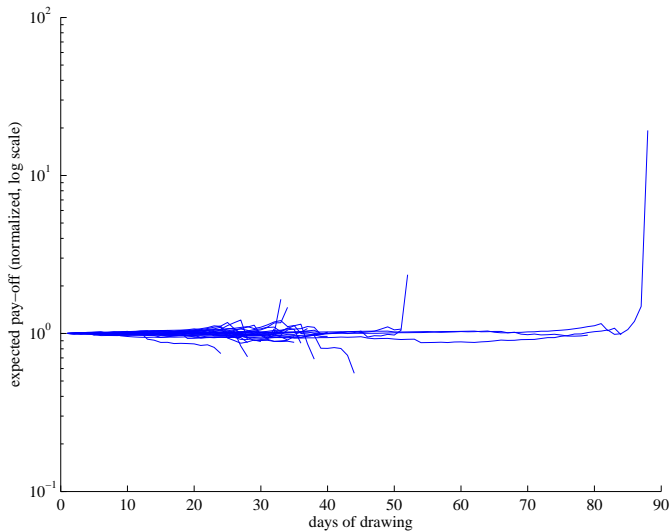
Variance of prizes and market risk “premium”



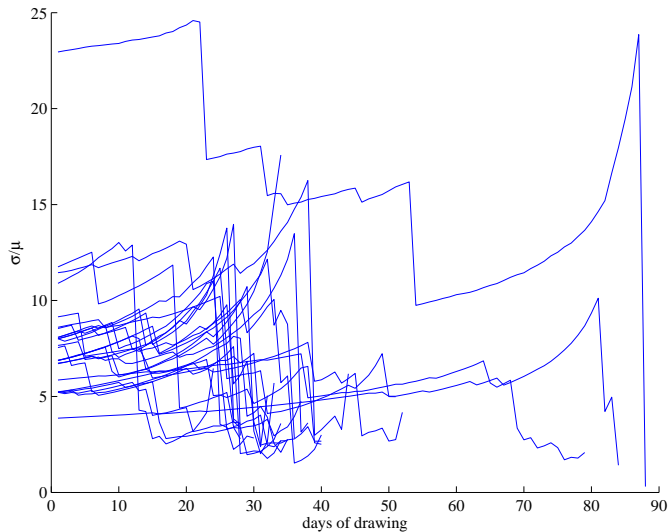
Skewness of prizes and market risk “premium”



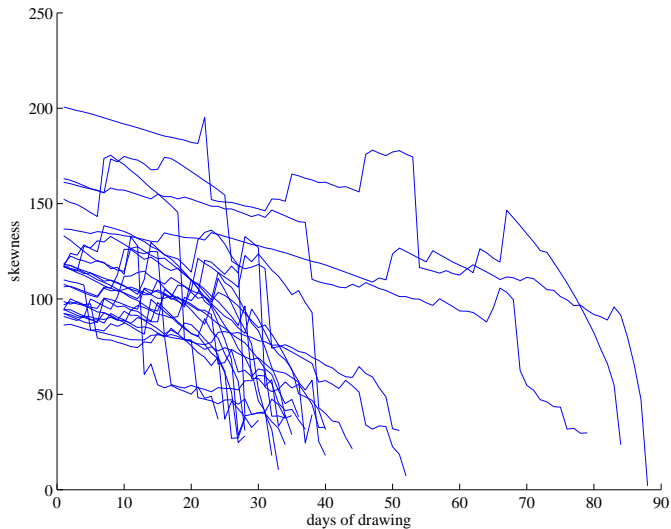
The Draws



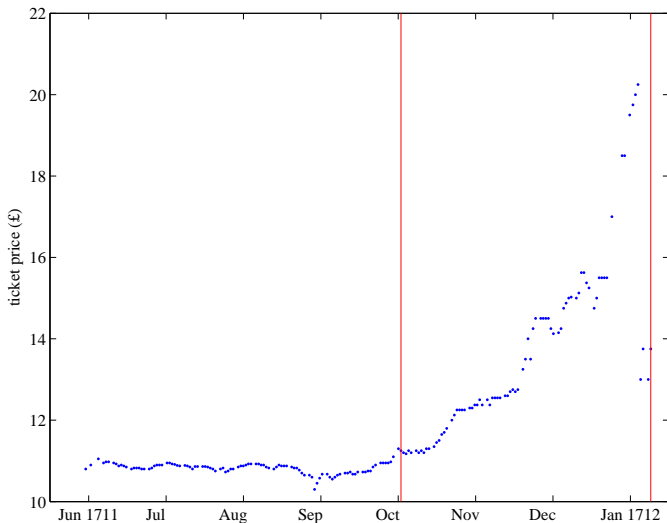
The Draws



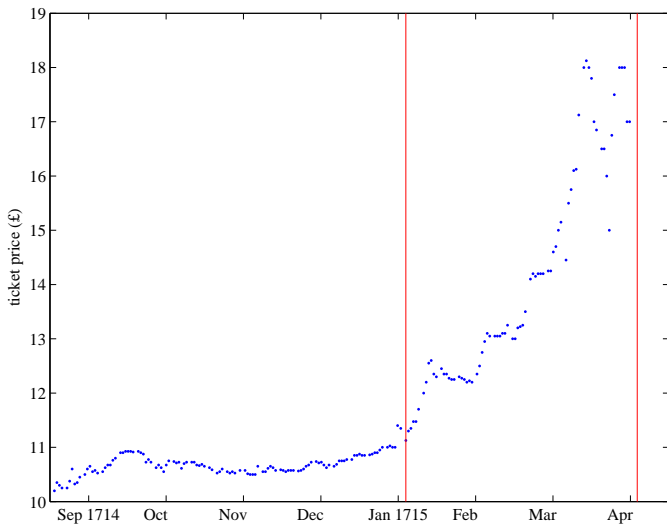
The Draws



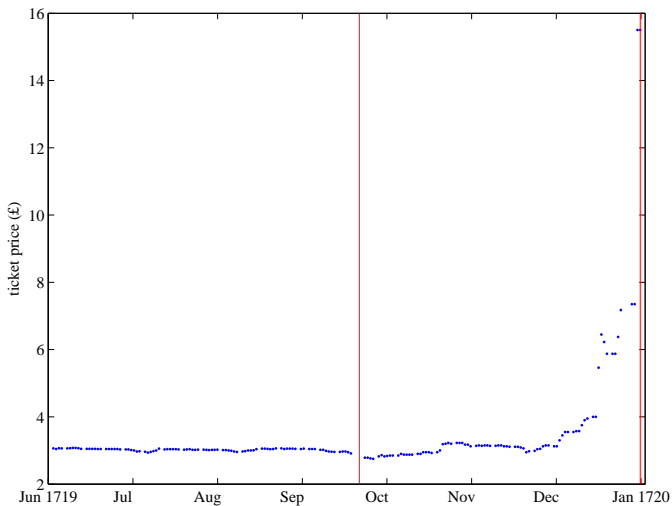
Ticket Prices



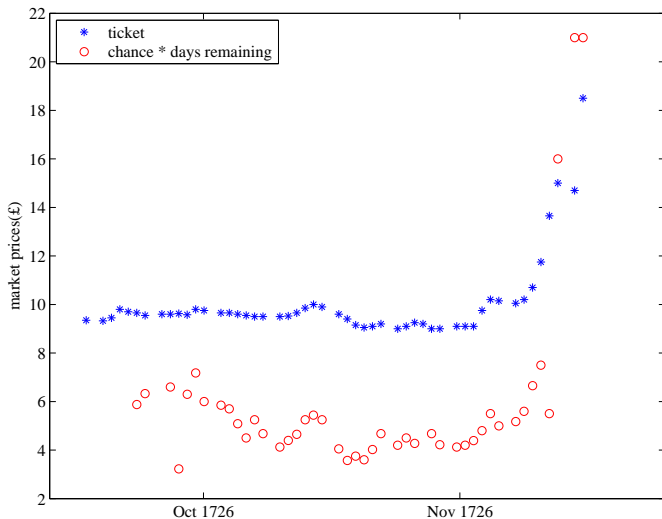
Ticket Prices



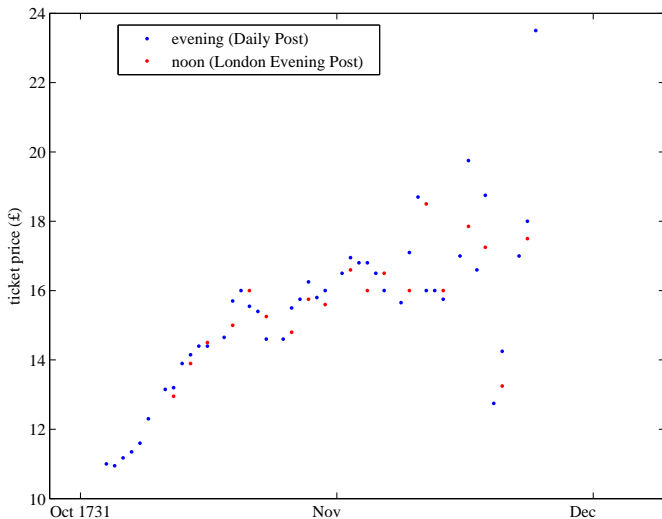
Ticket Prices



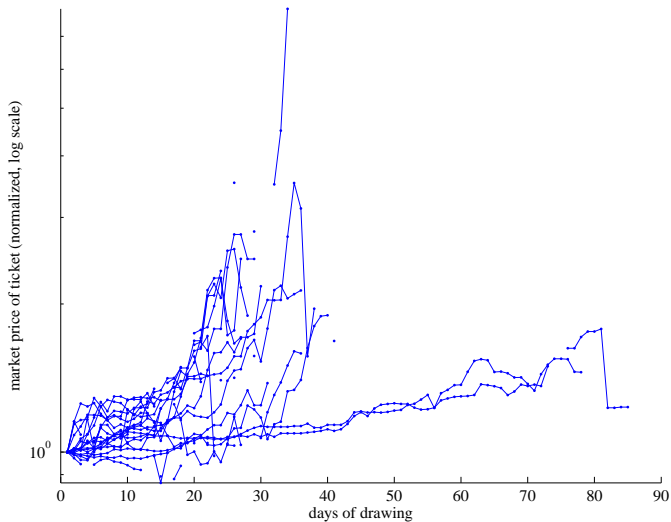
Ticket Prices



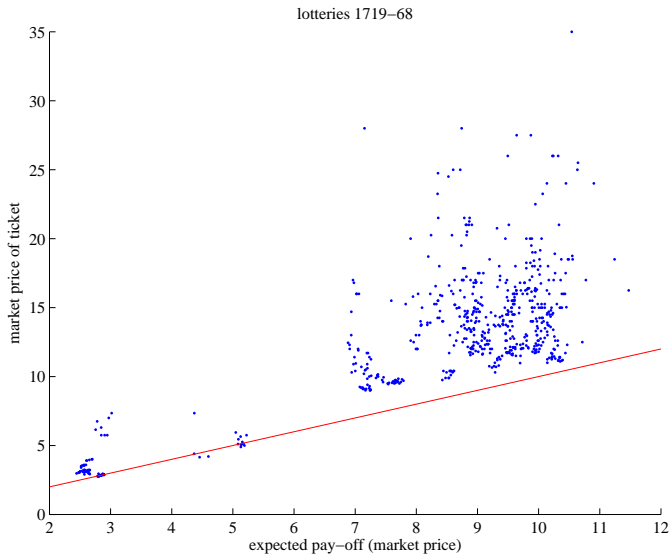
Ticket Prices



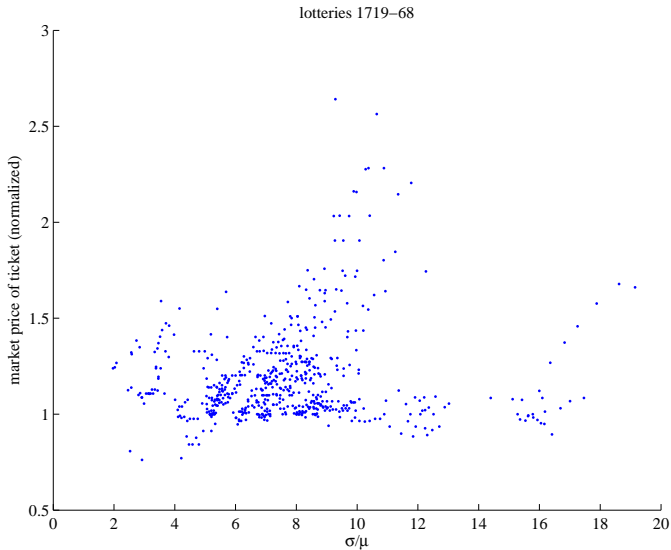
Pattern of prices during the draw



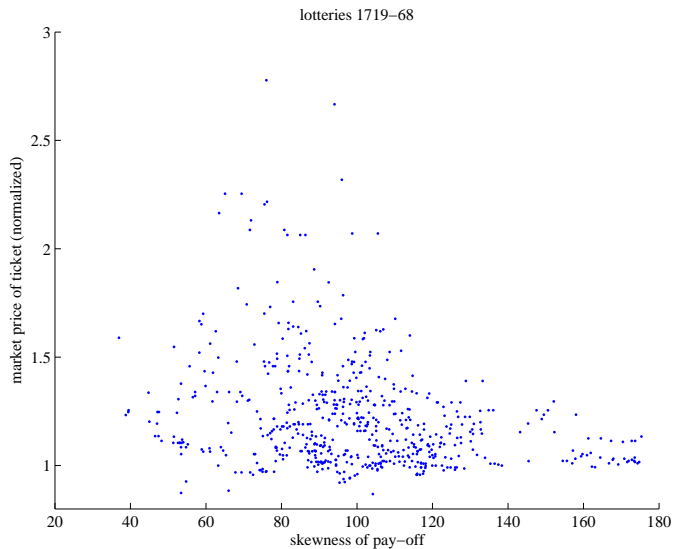
Prices and moments



Prices and moments



Prices and moments



Determining the “value” of each prize

let

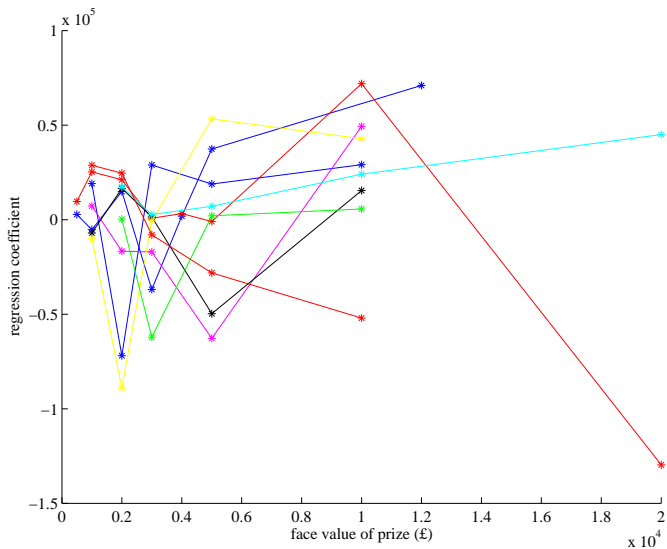
- ▶ p_t the market price of a lottery ticket during the draw ($1 \leq t \leq T$)
- ▶ π_{it} the probability of earning prize i between t and T

Regress

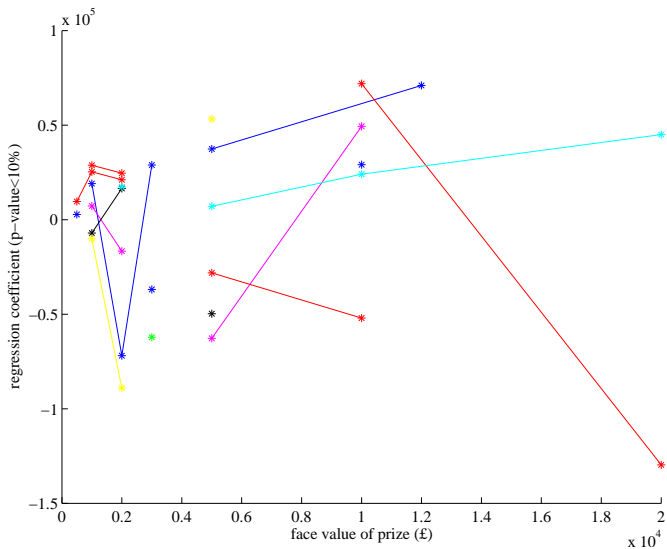
$$p_t = \sum_{i=1}^{N-1} \pi_{it} V_i + \epsilon_t$$



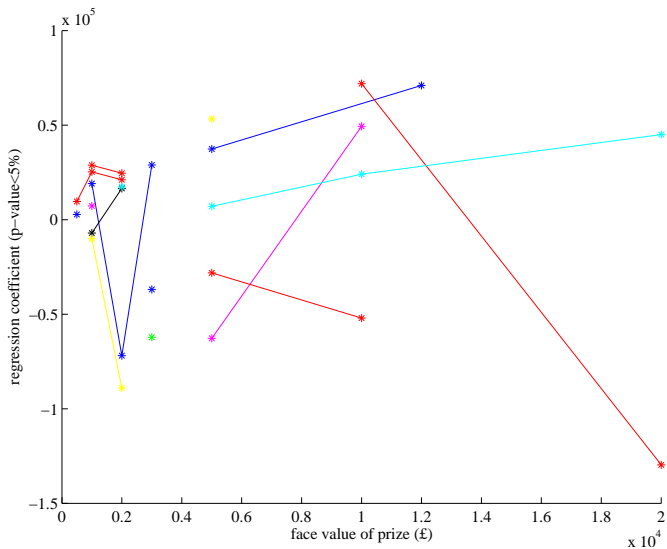
Regression results



Regression results



Regression results



Prospect theory

valuation of a gamble $\{(x_i, p_i)\}$ by investor with wealth W :

- ▶ expected utility

$$\sum_i p_i u(W + x_i) \quad (1)$$

- ▶ concavity will be a problem!
- ▶ prospect theory (Kahneman and Tversky, 1979)

$$\sum \pi(p_i) v(x_i) \quad (2)$$

with

- ▶ v concave over gains, convex over losses, kinked at origin
- ▶ π probability weighting function

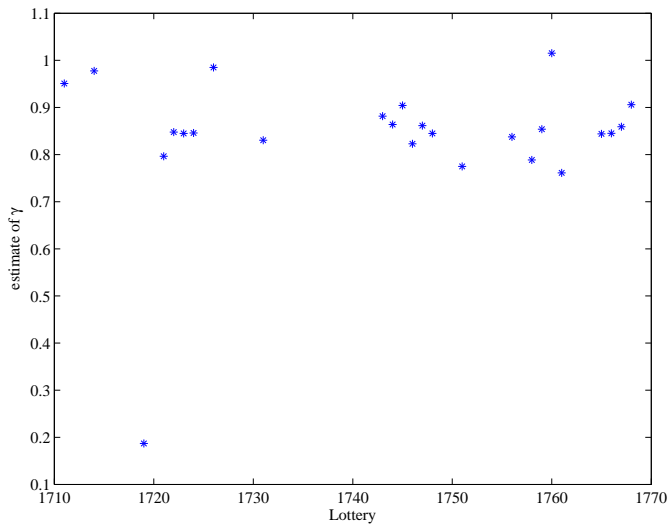


Prospect Theory

- ▶ take price to equal valuation by PT investor
- ▶

$$\pi(p) = \frac{p^\gamma}{(\sum p_i^\gamma)^{1/\gamma}} \quad (3)$$



Estimates of γ 

Cumulative Prospect theory

- ▶ (Tversky and Kahneman, 1992)

$$\sum_{i=-m}^n \pi_i v(x_i) \quad (4)$$

with

- ▶ ordered lottery $(x_{-m}, p_{-m}; \dots; x_{-1}, p_{-1}; x_0, p_0; x_1, p_1; \dots; x_n, p_n)$
- ▶

$$\pi_i = \begin{cases} w^+(p_i + \dots + p_n) - w^+(p_{i+1} + \dots + p_n) & 0 \leq i \leq n \\ w^-(p_{-m} + \dots + p_i) - w^-(p_{-m} + \dots + p_{i-1}) & -m \leq i \leq 0 \end{cases} \quad (5)$$



Cumulative Prospect Theory

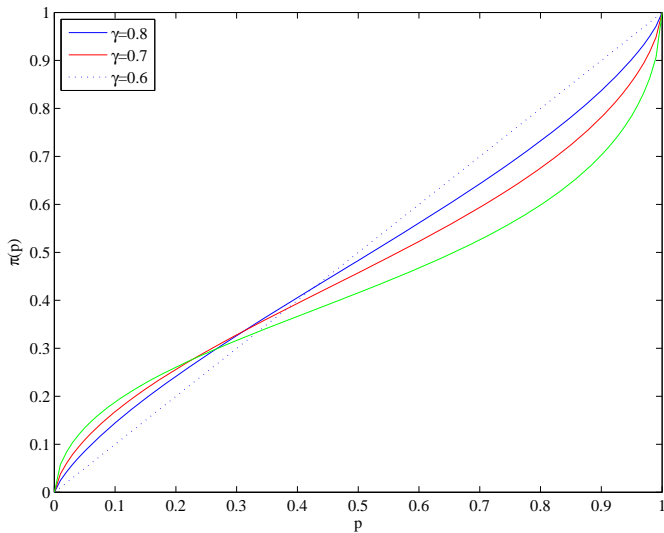
- ▶ take price to equal valuation by CPT investor
- ▶ use Tversky and Kahneman (1992)

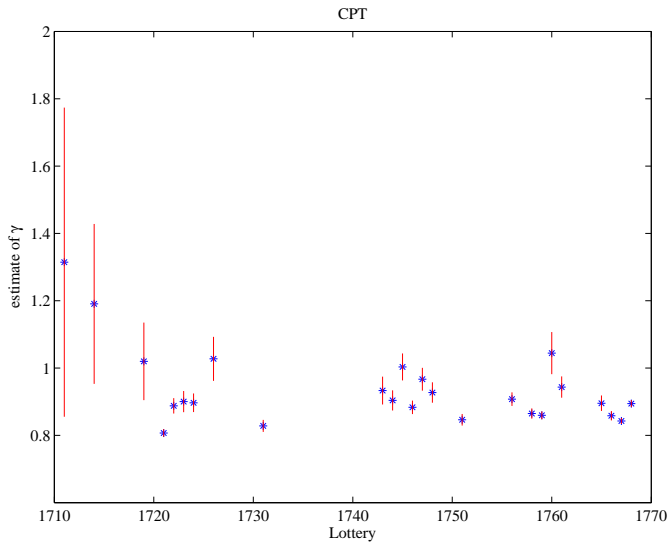
$$\begin{cases} w^+(p) &= \frac{p^\gamma}{(p^\gamma + (1-p)^\gamma)^{1/\gamma}} \\ w^-(p) &= \frac{p^\delta}{(p^\delta + (1-p)^\delta)^{1/\delta}} \end{cases} \quad (6)$$

who estimate $\gamma = 0.61$, $\delta = 0.69$



Weighting function





Equilibrium with CPT investors

Barberis and Huang (2008)

- ▶ investors with CPT preferences
- ▶ safe asset, normally distributed asset, and independent skewed asset (lottery) in small supply
- ▶ there are equilibria with “overpriced” skewed asset

Conclusion

- ▶ Lottery loans were frequently used to issue substantial sums
- ▶ They offered highly skewed returns, but did not add permanent risk to portfolios
- ▶ The PDFs of the returns were well-known, uncorrelated with anything else
- ▶ Market prices display negative excess returns, increasing over the course of the draws
- ▶ Investors were well-to-do and savvy Englishmen
- ▶ They cared about certain aspects of the prize distribution (insurance, experimentation by State)
- ▶ Much remains to do...



Th-th-th-that's all folks!