Acorn's Example Data for Competitive Bidding Analysis

Acorn's competitive bidding experience for the past 48 projects is shown below.
For each project j, the table shows the contractor's estimated cost as well as the bid prices submitted by his n_j opponents. This table does not include the contractor's own bid price.
Each B_{ij} column shows the bid prices submitted a particular contractor (the ith opponent).

Project	Contr. Est.	Opponent's Bids, Bij ($k)						
No. j	$E[C_{0j}]$ ($k)	B_{1j}	B_{2j}	B_{3j}	B_{4j}	$B_{5}j$	B_{6j}	B_{7j}
1	45,943	50,950	53,964					54,321
2	6,343		6,738	6,655		6,729	7,187	
3	6,586	6,647		6,627	6,566	6,683	6,276	
4	6,757		7,890				7,400	
5	374,918			416,000		456,602	440,399	
6	136,775	160,058	156,545	155,827	148,600		150,990	158,197
7	5,064					4,500		4,640
8	87,535	99,474		98,759		96,000		97,187
9	12,303		15,000	16,301	16,493	16,058	15,129	
10	50,884		59,800	61,723		65,647		
11	6,588					7,015		7,361
12	56,368	49,369			46,900	48,441		
13	31,750					33,734	33,660	34,976
14	46,020	56,312			56,883		56,664	53,600
15	193,478	244,696	239,742	241,474	247,419			243,914
16	515,613	622,323	616,545	579,600		585,242		
17	189,577	213,400	213,700	231,068				214,812
18	230,162	210,680	193,800					
19	195,398	200,707	209,772		208,239	194,000		195,132
20	22,275	24,735			24,759		22,844	
21	24,383	20,000		21,943				
22	5,073				5,405	5,400	5,820	
23	56,442	47,724	46,910	46,448		48,971	44,800	
24	42,411			45,410	41,600			45,565
25	42,065		44,300	46,587	45,437	46,077		46,631
26	359,068	380,747	371,130	372,891	381,987	392,651	360,000	370,685
27	8,155		9,659					9,069
28	39,467						35,060	33,700
29	263,552	252,665	244,101		254,511	259,750	239,650	258,998
30	81,826	64,945		65,836		69,080	68,363	63,200
31	8,994	9,194						8,450
32	13,985	12,166	12,139		12,455		11,789	
33	262,185		268,876				291,621	282,492
34	22,414	23,713	22,000	23,879	23,580	23,943	22,943	23,611
35	21,274	23,619			24,285		22,231	23,246
36	434,925		456,421		438,334	437,600	434,300	
37	482,774						584,942	532,759
38	163,268		129,342	133,722	140,800			131,215
39	35,179	41,700	45,644	45,256	45,758	45,625	43,576	44,537
40	92,130		80,200	82,380				
41	85,998	86,737	84,785	88,391	81,000	82,933	83,059	87,203
42	266,274		289,879		269,967		284,179	
43	16,416			15,423		14,741		
44	686,409			658,207	623,600	630,813		
45	266,781		264,170	251,633			252,576	249,240
46	281,405		273,447	264,872	279,650		269,039	
47	50,906	57,567					54,964	58,425
48	459,391			452,356		428,846	421,400	

For competitive bidding analysis using Friedman's and Gates' bidding models,
we need the expected value and valiance of all BC_{ij}:

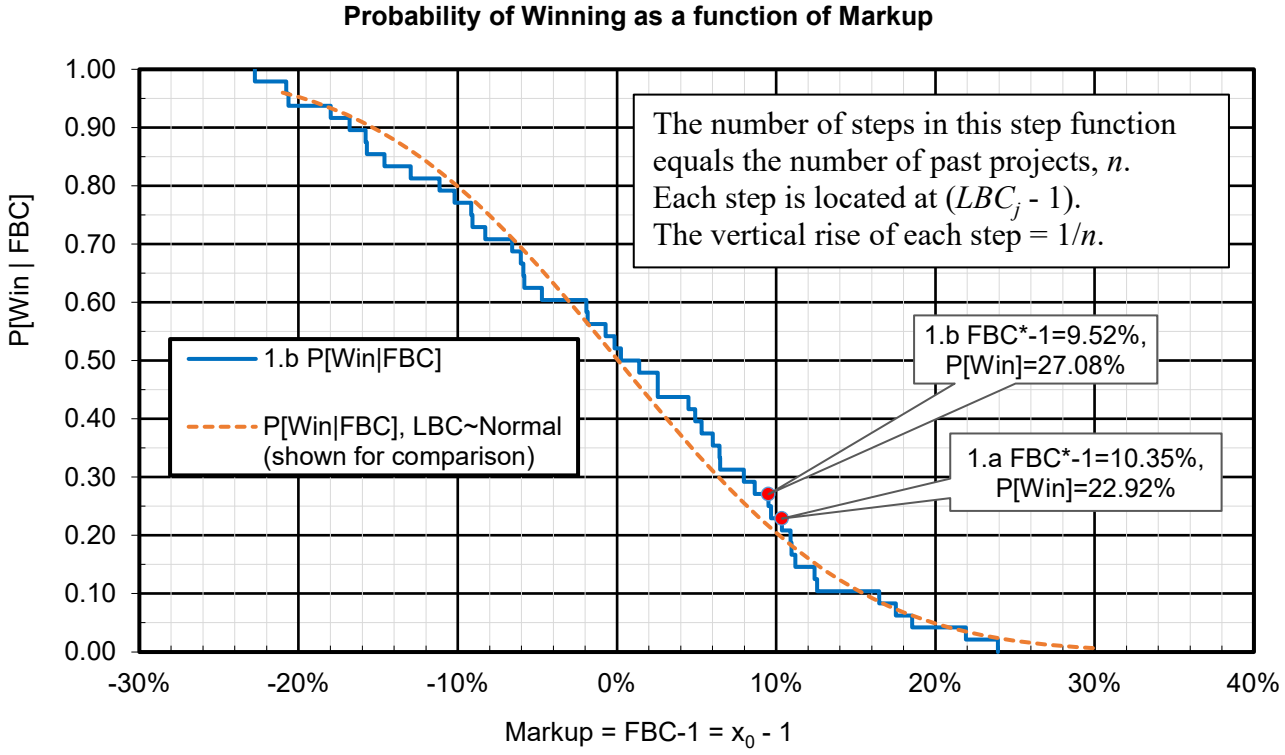
E[LBCij]=	1.00073	E[BC_{ij}]=	1.0462057
SD[LBCij]=	0.1201573	SD[BC_{ij}]=	0.1314654
min[LBCij]=	0.77237	min[BC_{ij}]=	0.77237
max[LBCij]=	1.23912	max[BC_{ij}]=	1.34057

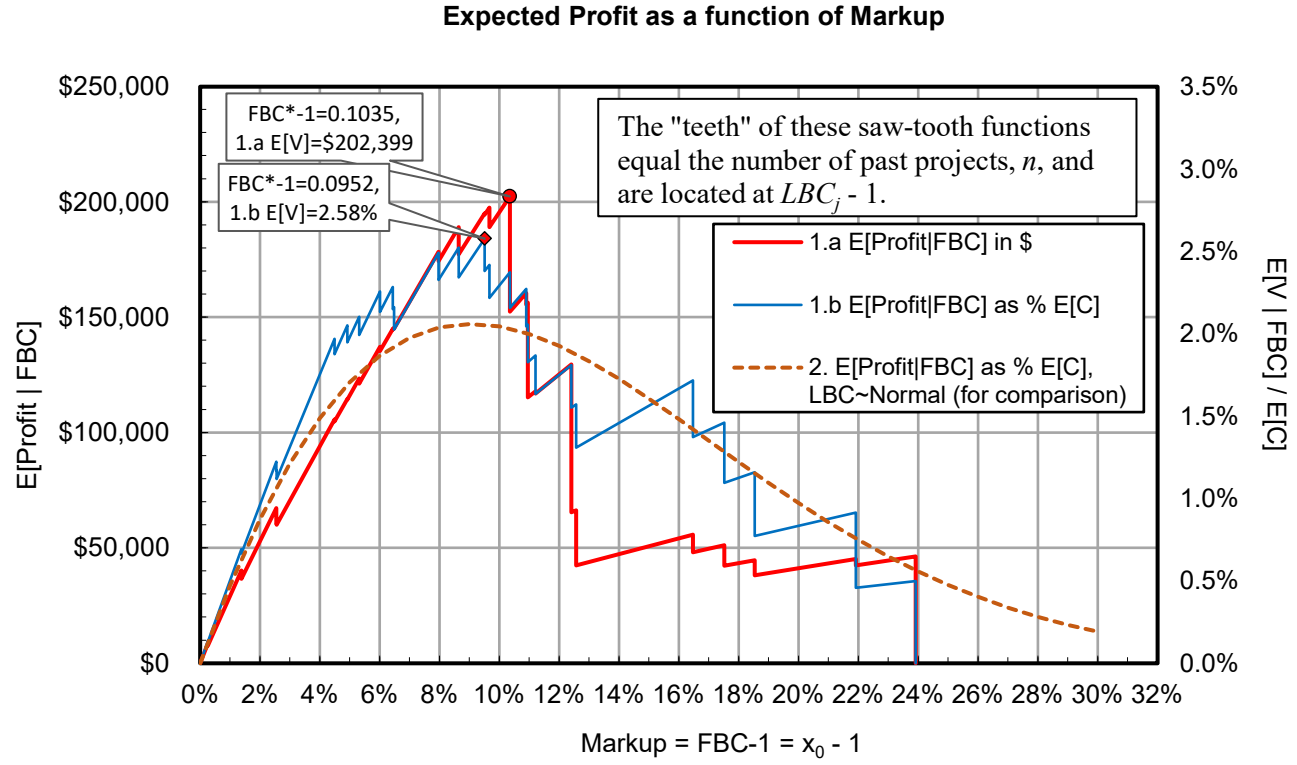
		k=	1	2	3	4	5	6	7
N=Σ(n_k)=	48	n_k=	0	11	13	11	7	2	4
		P[N=k] = n_k/N =	0.00%	22.92%	27.08%	22.92%	14.58%	4.17%	8.33%
Project No. j	LBC_j	k_j	Opponent's Bid-to-Cost Ratios, $BC_{ij} = B_{ij} / C_{0j}$						
			B_{1j}	B_{2j}	B_{3j}	B_{4j}	B_{5j}	B_{6j}	B_{7j}
1	1.10898	3	1.10898	1.17459					1.18236
2	1.04919	4		1.06227	1.04919		1.06085	1.13306	
3	0.95293	5	1.00926		1.00623	0.99696	1.01473	0.95293	
4	1.09516	2		1.16768				1.09516	
5	1.10958	3			1.10958		1.21787	1.17465	
6	1.08646	6	1.17023	1.14454	1.13929	1.08646		1.10393	1.15662
7	0.88863	2					0.88863		0.91627
8	1.09670	4	1.13639		1.12822		1.09670		1.11026
9	1.21921	5		1.21921	1.32496	1.34057	1.30521	1.22970	
10	1.17522	3		1.17522	1.21301		1.29013		
11	1.06481	2					1.06481		1.11733
12	0.83203	3	0.87583			0.83203	0.85937		
13	1.06016	3					1.06249	1.06016	1.10161
14	1.16471	4	1.22364			1.23605		1.23129	1.16471
15	1.23912	5	1.26472	1.23912	1.24807	1.27880			1.26068
16	1.12410	4	1.20696	1.19575	1.12410		1.13504		
17	1.12566	4	1.12566	1.12725	1.21886				1.13311
18	0.84202	2	0.91536	0.84202					
19	0.99285	5	1.02717	1.07356		1.06572	0.99285		0.99864
20	1.02554	3	1.11044			1.11152		1.02554	
21	0.82024	2	0.82024		0.89993				
22	1.06446	3				1.06544	1.06446	1.14725	
23	0.79374	5	0.84554	0.83112	0.82293		0.86763	0.79374	
24	0.98088	3			1.07071	0.98088			1.07437
25	1.05313	5		1.05313	1.10750	1.08016	1.09538		1.10855
26	1.00260	7	1.06038	1.03359	1.03850	1.06383	1.09353	1.00260	1.03235
27	1.11208	2		1.18443					1.11208
28	0.85388	2						0.88834	0.85388
29	0.90931	6	0.95869	0.92620		0.96570	0.98557	0.90931	0.98272
30	0.77237	5	0.79370		0.80459		0.84423	0.83547	0.77237
31	0.93952	2	1.02224						0.93952
32	0.84297	4	0.86993	0.86800		0.89060		0.84297	
33	1.02552	3		1.02552				1.11227	1.07745
34	0.98153	7	1.05795	0.98153	1.06536	1.05202	1.06822	1.02360	1.05340
35	1.04498	4	1.11023			1.14153		1.04498	1.09270
36	0.99856	4		1.04942		1.00784	1.00615	0.99856	
37	1.10354	2						1.21163	1.10354
38	0.79221	4		0.79221	0.81903	0.86239			0.80368
39	1.18537	7	1.18537	1.29748	1.28645	1.30072	1.29694	1.23869	1.26601
40	0.87051	2		0.87051	0.89417				
41	0.94188	7	1.00859	0.98590	1.02783	0.94188	0.96436	0.96582	1.01401
42	1.01387	3		1.08865		1.01387		1.06724	
43	0.89797	2			0.93951		0.89797		
44	0.90850	3			0.95891	0.90850	0.91900		
45	0.93425	4		0.99021	0.94322			0.94675	0.93425
46	0.94125	4		0.97172	0.94125	0.99376		0.95606	
47	1.07972	3	1.13085					1.07972	1.14770
48	0.91730	3			0.98469		0.93351	0.91730	

Brute-Force (Statistical) Analysis based on Acorn's Historical Bid Data

Projects		Opponents'	LBC_j			P[W]	E[V] By $ Profit		E[V] By (#Projects Won)/N		
	Est.	Low Bid	Rank		ΣC_k	Markup	@LBC-ε	(FBC-1)ΣC_k	(FBC-1) r/N		
j	Cost	LBj	r	LBC_r = FBC	k=1,..,r	LBC-1	r/N	@LBC-ε	@LBC+ε	@LBC-ε	@LBC+ε
15	193,478	239,742	1	1.239	193,478	23.912%	0.02	46264.00	0.00	0.50%	0.00%
9	12,303	15,000	2	1.219	205,781	21.921%	0.04	45110.25	42413.25	0.91%	0.46%
39	35,179	41,700	3	1.185	240,960	18.537%	0.06	44665.86	38144.86	1.16%	0.77%
10	50,884	59,800	4	1.175	291,844	17.522%	0.08	51137.51	42221.51	1.46%	1.10%
14	46,020	53,600	5	1.165	337,864	16.471%	0.10	55649.92	48069.92	1.72%	1.37%
17	189,577	213,400	6	1.126	527,441	12.566%	0.13	66280.33	42457.33	1.57%	1.31%
16	515,613	579,600	7	1.124	1,043,054	12.410%	0.15	129441.84	65454.84	1.81%	1.55%
27	8,155	9,069	8	1.112	1,051,209	11.208%	0.17	117817.91	116903.91	1.87%	1.63%
5	374,918	416,000	9	1.110	1,426,127	10.958%	0.19	156269.24	115187.24	2.05%	1.83%
1	45,943	50,950	10	1.109	1,472,070	10.898%	0.21	160430.41	155423.41	2.27%	2.04%
37	482,774	532,759	11	1.104	1,954,844	10.354%	0.23	202398.80 10.354%	152413.80	2.37%	2.16%
8	87,535	96,000	12	1.097	2,042,379	9.670%	0.25	197506.58	189041.58	2.42%	2.22%
4	6,757	7,400	13	1.095	2,049,136	9.516%	0.27	194996.96	194353.96 9.516%	2.58% 9.516%	2.38% 9.516%
6	136,775	148,600	14	1.086	2,185,911	8.646%	0.29	188984.81	177159.81	2.52%	2.34%
47	50,906	54,964	15	1.080	2,236,817	7.972%	0.31	178309.11	174251.11	2.49%	2.33%
11	6,588	7,015	16	1.065	2,243,405	6.481%	0.33	145405.88	144978.88	2.16%	2.03%
22	5,073	5,400	17	1.064	2,248,478	6.446%	0.35	144934.42	144607.42	2.28%	2.15%
13	31,750	33,660	18	1.060	2,280,228	6.016%	0.38	137172.77	135262.77	2.26%	2.13%
25	42,065	44,300	19	1.053	2,322,293	5.313%	0.40	123388.21	121153.21	2.10%	1.99%
2	6,343	6,655	20	1.049	2,328,636	4.919%	0.42	114541.14	114229.14	2.05%	1.95%
35	21,274	22,231	21	1.045	2,349,910	4.498%	0.44	105709.50	104752.50	1.97%	1.87%
20	22,275	22,844	22	1.026	2,372,185	2.554%	0.46	60595.88	60026.88	1.17%	1.12%
33	262,185	268,876	23	1.026	2,634,370	2.552%	0.48	67229.51	60538.51	1.22%	1.17%
42	266,274	269,967	24	1.014	2,900,644	1.387%	0.50	40229.53	36536.53	0.69%	0.66%
26	359,068	360,000	25	1.003	3,259,712	0.260%	0.52	8460.94	7528.94	0.14%	0.13%
36	434,925	434,300	26	0.999	3,694,637	-0.144%	0.54	-5309.30	-4684.30	-0.08%	-0.07%
19	195,398	194,000	27	0.993	3,890,035	-0.715%	0.56	-27831.75	-26433.75	-0.40%	-0.39%
34	22,414	22,000	28	0.982	3,912,449	-1.847%	0.58	-72265.28	-71851.28	-1.08%	-1.04%
24	42,411	41,600	29	0.981	3,954,860	-1.912%	0.60	-75626.40	-74815.40	-1.16%	-1.12%
3	6,586	6,276	30	0.953	3,961,446	-4.707%	0.63	-186463.45	-186153.45	-2.94%	-2.84%
41	85,998	81,000	31	0.942	4,047,444	-5.812%	0.65	-235227.86	-230229.86	-3.75%	-3.63%
46	281,405	264,872	32	0.941	4,328,849	-5.875%	0.67	-254326.90	-237793.90	-3.92%	-3.79%
31	8,994	8,450	33	0.940	4,337,843	-6.048%	0.69	-262373.43	-261829.43	-4.16%	-4.03%
45	266,781	249,240	34	0.934	4,604,624	-6.575%	0.71	-302756.60	-285215.60	-4.66%	-4.52%
48	459,391	421,400	35	0.917	5,064,015	-8.270%	0.73	-418787.03	-380796.03	-6.03%	-5.86%
29	263,552	239,650	36	0.909	5,327,567	-9.069%	0.75	-483166.53	-459264.53	-6.80%	-6.61%
44	686,409	623,600	37	0.908	6,013,976	-9.150%	0.77	-550301.38	-487492.38	-7.05%	-6.86%
43	16,416	14,741	38	0.898	6,030,392	-10.203%	0.79	-615308.64	-613633.64	-8.08%	-7.87%
7	5,064	4,500	39	0.889	6,035,456	-11.137%	0.81	-672195.34	-671631.34	-9.05%	-8.82%
40	92,130	80,200	40	0.871	6,127,586	-12.949%	0.83	-793466.85	-781536.85	-10.79%	-10.52%
28	39,467	33,700	41	0.854	6,167,053	-14.612%	0.85	-901142.59	-895375.59	-12.48%	-12.18%
32	13,985	11,789	42	0.843	6,181,038	-15.703%	0.88	-970579.87	-968383.87	-13.74%	-13.41%
18	230,162	193,800	43	0.842	6,411,200	-15.798%	0.90	-1012869.43	-976507.43	-14.15%	-13.82%
12	56,368	46,900	44	0.832	6,467,568	-16.797%	0.92	-1086342.14	-1076874.14	-15.40%	-15.05%
21	24,383	20,000	45	0.820	6,491,951	-17.976%	0.94	-1166969.66	-1162586.66	-16.85%	-16.48%
23	56,442	44,800	46	0.794	6,548,393	-20.626%	0.96	-1350703.22	-1339061.22	-19.77%	-19.34%
38	163,268	129,342	47	0.792	6,711,661	-20.779%	0.98	-1394638.33	-1360712.33	-20.35%	-19.91%
30	81,826	63,200	48	0.772	6,793,487	-22.763%	1.00	-1546397.10	-1527771.10	-22.76%	-22.29%
		AVG(LBC) =		1.0007328			Max Profit:	202,398.80	194,353.96	2.58%	2.38%
		STD(LBC) =		0.1201573			Markup = FBC*-1 :	10.354%	9.516%	9.516%	9.516%

Brute-Force (Statistical) Analysis based on Acorn's Historical Bid Data





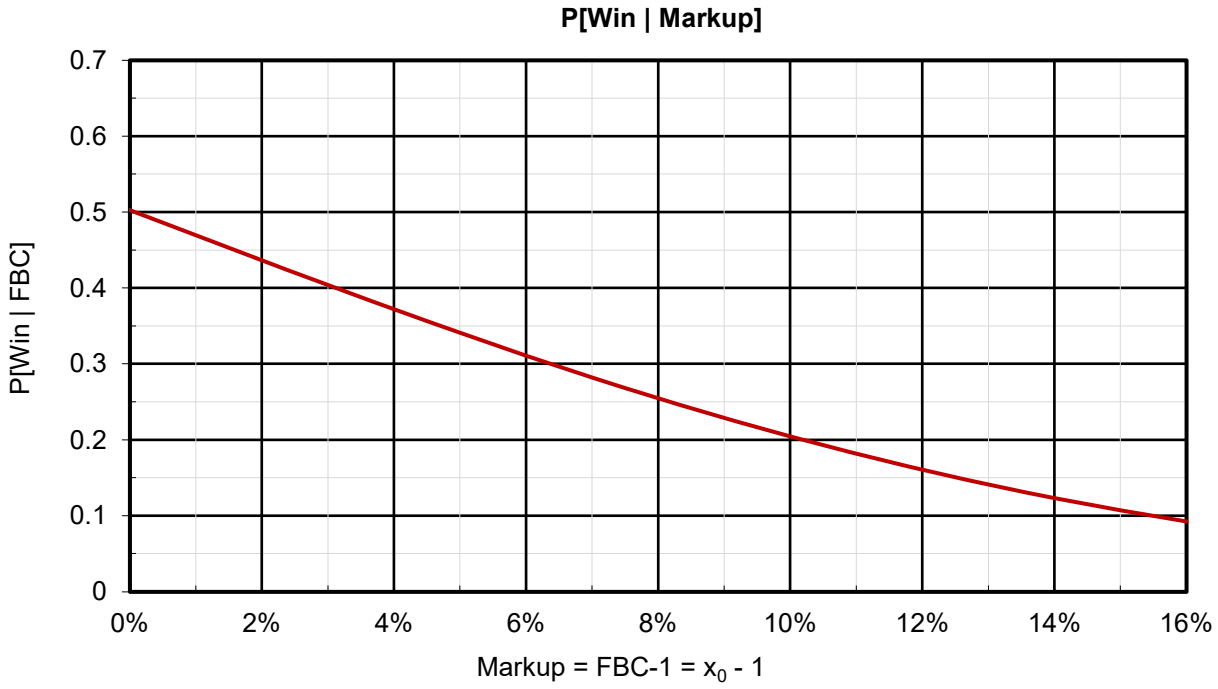
Probabilistic Analysis based on Acorn's Historical Bid Data
Under the Assumption that LBC follows Normal Distribution
Note: Use Excel Solver to maxE[V|FBC].
Note: The table below is used to produce **smooth** graphs and to **verify** FBC*.

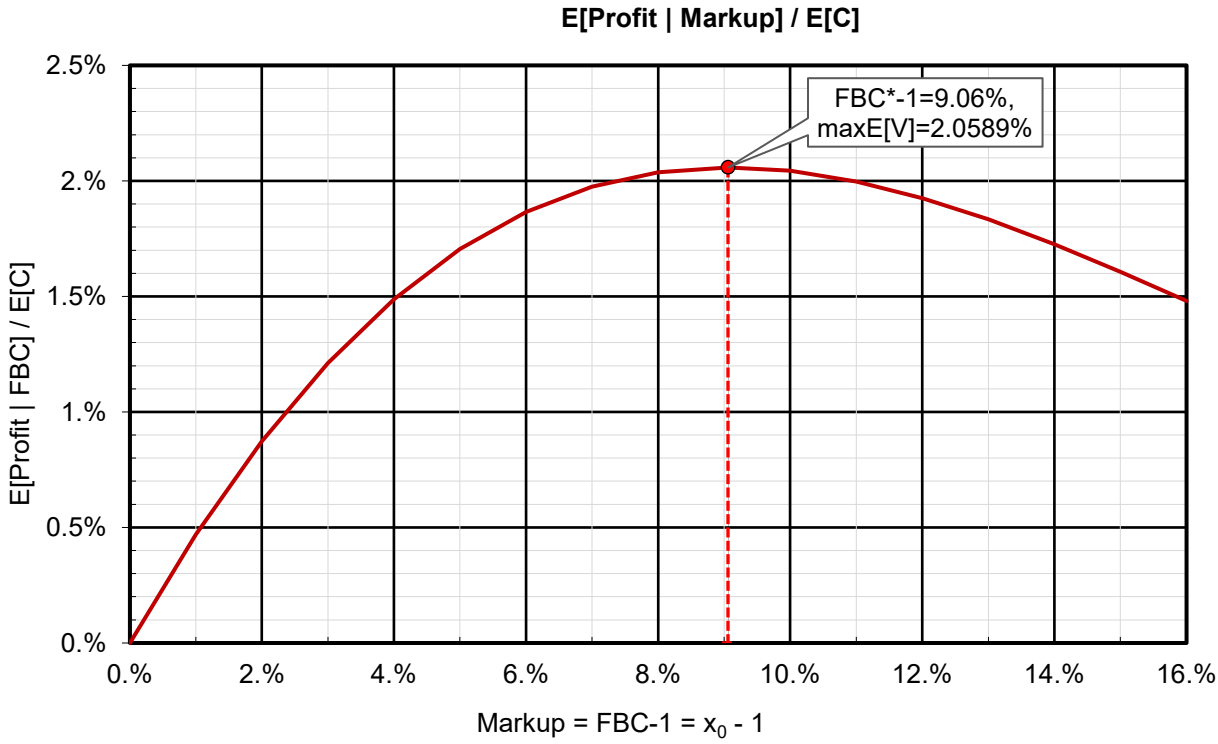
E[LBC] =	1.000732792
SD[LBC] =	0.120157339

FBC-1	FBC	P[W|FBC]	E[Profit|FBC] /C = (FBC-1)P[W|FBC]
-4.%	0.96	0.632693423	-2.531%
-3.%	0.97	0.60093626	-1.803%
-2.%	0.98	0.568496254	-1.137%
-1.%	0.99	0.535587319	-0.536%
0.%	1	0.502432976	0.%
1.%	1.01	0.46926181	0.469%
2.%	1.02	0.436302757	0.873%
3.%	1.03	0.40378037	1.211%
4.%	1.04	0.371910242	1.488%
5.%	1.05	0.340894736	1.704%
6.%	1.06	0.310919151	1.866%
7.%	1.07	0.282148471	1.975%
8.%	1.08	0.254724756	2.038%
9.06%	1.09055566	0.227367706	2.0589%
10.%	1.1	0.20436134	2.044%
11.%	1.11	0.181578023	1.997%
12.%	1.12	0.160454424	1.925%
13.%	1.13	0.141004741	1.833%
14.%	1.14	0.123219864	1.725%
15.%	1.15	0.107069478	1.606%
16.%	1.16	0.09250454	1.48%

Use Excel Solver to maximize E[V|FBC]/C			E[Profit|FBC*] /C =
FBC*-1	FBC*	P[W|FBC*]	(FBC-1)P[W|FBC]
9.06%	**1.0906**	**22.74%**	**2.0589%**

Probabilistic Analysis based on Acorn's Historical Bid Data
Under the Assumption that LBC follows Normal Distribution





Friedman's Model using Acorn's Historical Bid Data (Note: Normal pdf fits Acorn's B/C Data Best)

P[W|FBC] = [1-F(FBC)]^n E[B/C] = 1.04620567 SD[B/C] = 0.13146538

(Note: Use Excel Solver to maximize E[V|FBC]. Tables are used to produce smooth graphs and to verify FBC*.)

	n = 1			n = 3			n = 7		
FBC	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]
1.0000		63.7381%	0.%		25.8939%	0.%		4.2736%	0.%
1.0100		60.8496%	0.6085%		22.5306%	0.2253%		3.0889%	0.0309%
1.0200		57.9000%	1.158%		19.4104%	0.3882%		2.1815%	0.0436%
1.0210		57.6023%	1.2096%		19.1125%	0.4014%		2.1041%	0.0442%
1.0220		57.3041%	1.2607%		18.8173%	0.414%		2.0291%	0.0446%
1.0230		57.0055%	1.3111%		18.5247%	0.4261%		1.9562%	0.045%
1.0240		56.7066%	1.361%		18.2348%	0.4376%		1.8855%	0.0453%
1.0250		56.4072%	1.4102%		17.9475%	0.4487%		1.8170%	0.0454%
1.0260		56.1075%	1.4588%		17.6629%	0.4592%		1.7504%	0.0455%
1.0266		55.9216%	1.4886%		17.4880%	0.4655%	1.0266	1.7102%	0.0455%
1.0280		55.5070%	1.5542%		17.1019%	0.4789%		1.6234%	0.0455%
1.0290		55.2063%	1.601%		16.8254%	0.4879%		1.5629%	0.0453%
1.0300		54.9053%	1.6472%		16.5517%	0.4966%		1.5042%	0.0451%
1.0310		54.6040%	1.6927%		16.2807%	0.5047%		1.4473%	0.0449%
1.0320		54.3025%	1.7377%		16.0125%	0.5124%		1.3923%	0.0446%
1.0330		54.0006%	1.782%		15.7470%	0.5196%		1.3390%	0.0442%
1.0340		53.6986%	1.8258%		15.4842%	0.5265%		1.2875%	0.0438%
1.0350		53.3963%	1.8689%		15.2242%	0.5328%		1.2376%	0.0433%
1.0360		53.0939%	1.9114%		14.9670%	0.5388%		1.1894%	0.0428%
1.0370		52.7913%	1.9533%		14.7125%	0.5444%		1.1427%	0.0423%
1.0380		52.4885%	1.9946%		14.4608%	0.5495%		1.0976%	0.0417%
1.0390		52.1855%	2.0352%		14.2118%	0.5543%		1.0540%	0.0411%
1.0400		51.8825%	2.0753%		13.9657%	0.5586%		1.0119%	0.0405%
1.0500		48.8487%	2.4424%		11.6563%	0.5828%		0.6637%	0.0332%
1.0510		48.5454%	2.4758%		11.4405%	0.5835%		0.6354%	0.0324%
1.0520		48.2422%	2.5086%		11.2275%	0.5838%		0.6081%	0.0316%
1.0528		48.0017%	2.5342%	1.0528	11.0603%	0.5839%		0.5872%	0.031%
1.0540		47.6361%	2.5724%		10.8096%	0.5837%		0.5566%	0.0301%
1.0550		47.3333%	2.6033%		10.6047%	0.5833%		0.5323%	0.0293%
1.0560		47.0306%	2.6337%		10.4026%	0.5825%		0.5089%	0.0285%
1.0570		46.7281%	2.6635%		10.2031%	0.5816%		0.4865%	0.0277%
1.0580		46.4257%	2.6927%		10.0064%	0.5804%		0.4648%	0.027%
1.0590		46.1236%	2.7213%		9.8123%	0.5789%		0.4441%	0.0262%
1.0600		45.8217%	2.7493%		9.6208%	0.5772%		0.4241%	0.0254%
1.0700		42.8186%	2.9973%		7.8505%	0.5495%		0.2639%	0.0185%
1.0800		39.8567%	3.1885%		6.3314%	0.5065%		0.1598%	0.0128%
1.0900		36.9520%	3.3257%		5.0456%	0.4541%		0.0941%	0.0085%
1.0950		35.5260%	3.375%		4.4837%	0.426%		0.0714%	0.0068%
1.1000		34.1200%	3.412%		3.9722%	0.3972%		0.0538%	0.0054%
1.1050		32.7357%	3.4372%		3.5080%	0.3683%		0.0403%	0.0042%
1.1100		31.3747%	3.4512%		3.0885%	0.3397%		0.0299%	0.0033%
1.1140	1.1140	30.2931%	3.4546%		2.7799%	0.317%		0.0234%	0.0027%
1.1200		28.7289%	3.4475%		2.3711%	0.2845%		0.0162%	0.0019%
1.1250		27.4468%	3.4309%		2.0676%	0.2585%		0.0117%	0.0015%
1.1300		26.1936%	3.4052%		1.7972%	0.2336%		0.0085%	0.0011%
	FBC*	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**
	1.1140	0.3029307	**3.4546%**	**1.0528**	0.1106035	**0.5839%**	**1.0266**	0.0171024	**0.0455%**

Gates' Model using Acorn's Historical Bid Data (Note: Normal pdf fits Acorn's B/C Data Best)

P[W|FBC] = 1/{1+nF(FBC)/[1-F(FBC)]} E[B/C] = 1.04620567 SD[B/C] = 0.13146538

(Note: Use Excel Solver to maximize E[V|FBC]. Tables are used to produce smooth graphs and to verify FBC*.)

	n = 1			n = 3			n = 7		
FBC	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]
1.0000		63.7381%	0.%		36.9445%	0.%		20.0705%	0.%
1.0100		60.8496%	0.6085%		34.1275%	0.3413%		18.1693%	0.1817%
1.0200		57.9000%	1.158%		31.4332%	0.6287%		16.4209%	0.3284%
1.0300		54.9053%	1.6472%		28.8688%	0.8661%		14.8165%	0.4445%
1.0310		54.6040%	1.6927%		28.6197%	0.8872%		14.6637%	0.4546%
1.0320		54.3025%	1.7377%		28.3719%	0.9079%		14.5122%	0.4644%
1.0330		54.0006%	1.782%		28.1255%	0.9281%		14.3620%	0.4739%
1.0340		53.6986%	1.8258%		27.8805%	0.9479%		14.2132%	0.4832%
1.0350		53.3963%	1.8689%		27.6368%	0.9673%		14.0657%	0.4923%
1.0360		53.0939%	1.9114%		27.3945%	0.9862%		13.9194%	0.5011%
1.0370		52.7913%	1.9533%		27.1536%	1.0047%		13.7745%	0.5097%
1.0380		52.4885%	1.9946%		26.9140%	1.0227%		13.6309%	0.518%
1.0390		52.1855%	2.0352%		26.6758%	1.0404%		13.4886%	0.5261%
1.0400		51.8825%	2.0753%		26.4389%	1.0576%		13.3475%	0.5339%
1.0410		51.5793%	2.1148%		26.2035%	1.0743%		13.2077%	0.5415%
1.0420		51.2760%	2.1536%		25.9694%	1.0907%		13.0692%	0.5489%
1.0430		50.9727%	2.1918%		25.7367%	1.1067%		12.9319%	0.5561%
1.0440		50.6693%	2.2294%		25.5054%	1.1222%		12.7958%	0.563%
1.0450		50.3659%	2.2665%		25.2754%	1.1374%		12.6609%	0.5697%
1.0460		50.0624%	2.3029%		25.0468%	1.1522%		12.5273%	0.5763%
1.0470		49.7590%	2.3387%		24.8197%	1.1665%		12.3949%	0.5826%
1.0480		49.4555%	2.3739%		24.5938%	1.1805%		12.2637%	0.5887%
1.0490		49.1521%	2.4085%		24.3694%	1.1941%		12.1337%	0.5946%
1.0500		48.8487%	2.4424%		24.1464%	1.2073%		12.0049%	0.6002%
1.0510		48.5454%	2.4758%		23.9247%	1.2202%		11.8772%	0.6057%
1.0520		48.2422%	2.5086%		23.7044%	1.2326%		11.7507%	0.611%
1.0530		47.9391%	2.5408%		23.4856%	1.2447%		11.6254%	0.6161%
1.0540		47.6361%	2.5724%		23.2680%	1.2565%		11.5012%	0.6211%
1.0550		47.3333%	2.6033%		23.0519%	1.2679%		11.3782%	0.6258%
1.0560		47.0306%	2.6337%		22.8372%	1.2789%		11.2563%	0.6304%
1.0570		46.7281%	2.6635%		22.6238%	1.2896%		11.1355%	0.6347%
1.0580		46.4257%	2.6927%		22.4118%	1.2999%		11.0158%	0.6389%
1.0590		46.1236%	2.7213%		22.2012%	1.3099%		10.8973%	0.6429%
1.0600		45.8217%	2.7493%		21.9919%	1.3195%		10.7798%	0.6468%
1.0700		42.8186%	2.9973%		19.9749%	1.3982%		9.6637%	0.6765%
1.0800		39.8567%	3.1885%		18.0931%	1.4474%		8.6483%	0.6919%
1.0882		37.4682%	3.3049%		16.6478%	1.4684%	1.0882	7.8849%	0.6955%
1.0956		35.3650%	3.3798%	1.0956	15.4251%	1.4742%		7.2498%	0.6929%
1.1000		34.1200%	3.412%		14.7221%	1.4722%		6.8890%	0.6889%
1.1050		32.7357%	3.4372%		13.9581%	1.4656%		6.5005%	0.6826%
1.1100		31.3747%	3.4512%		13.2243%	1.4547%		6.1309%	0.6744%
1.1140	1.1140	30.2931%	3.4546%		12.6530%	1.443%		5.8454%	0.6666%
1.1200		28.7289%	3.4475%		11.8449%	1.4214%		5.4449%	0.6534%
1.1250		27.4468%	3.4309%		11.1979%	1.3997%		5.1272%	0.6409%
1.1300		26.1936%	3.4052%		10.5785%	1.3752%		4.8253%	0.6273%
	FBC*	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**
	1.1140	0.3029307	**3.4546%**	**1.0956**	0.1542505	**1.4742%**	**1.0882**	0.0788488	**0.6955%**

Friedman's Model (Unknown number of opponents, N)

P[W|FBC] = [1-F(FBC)]^n

E[B/C] =	1.04620567
SD[B/C] =	0.13146538

The FBC* shown below for n=1,2,…,7, are for comparison only. They are not needed to compute FBC* when the number of opponents N is a random variable.

	P[N=n] = 0.00%			P[N=n] = 22.92%			P[N=n] = 27.08%			P[N=n] = 22.92%			P[N=n] = 14.58%			P[N=n] = 4.17%			P[N=n] = 8.33%			P[N=n] = 100.00%		
	n = 1			n = 2			n = 3			n = 4			n = 5			n = 6			n = 7			N is a random variable		
FBC	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]
1.0000		0.6373808	0.%		0.4062543	0.%		0.2589387	0.%		0.1650425	0.%		0.1051949	0.%		0.0670492	0.%		0.0427359	0.%		22.2747%	0.%
1.0100		0.6084958	0.6085%		0.3702672	0.3703%		0.225306	0.2253%		0.1370978	0.1371%		0.0834234	0.0834%		0.0507628	0.0508%		0.030889	0.0309%		19.4147%	0.1941%
1.0200		0.5789997	1.158%		0.3352407	0.6705%		0.1941042	0.3882%		0.1123863	0.2248%		0.0650716	0.1301%		0.0376765	0.0754%		0.0218147	0.0436%		16.8028%	0.3361%
1.0210		0.5760226	1.2096%		0.331802	0.6968%		0.1911255	0.4014%		0.1100926	0.2312%		0.0634158	0.1332%		0.0365289	0.0767%		0.0210415	0.0442%		16.5554%	0.3477%
1.0220		0.5730411	1.2607%		0.3283761	0.7224%		0.188173	0.414%		0.1078309	0.2372%		0.0617915	0.1359%		0.0354091	0.0779%		0.0202909	0.0446%		16.3105%	0.3588%
1.0230		0.5700555	1.3111%		0.3249633	0.7474%		0.1852471	0.4261%		0.1056011	0.2429%		0.0601985	0.1385%		0.0343165	0.0789%		0.0195623	0.045%		16.0681%	0.3696%
1.0240		0.5670658	1.361%		0.3215637	0.7718%		0.1823478	0.4376%		0.1034032	0.2482%		0.0586364	0.1407%		0.0332507	0.0798%		0.0188553	0.0453%		15.8282%	0.3799%
1.0250		0.5640723	1.4102%		0.3181776	0.7954%		0.1794752	0.4487%		0.101237	0.2531%		0.057105	0.1428%		0.0322113	0.0805%		0.0181695	0.0454%		15.5908%	0.3898%
1.0260		0.5610752	1.4588%		0.3148054	0.8185%		0.1766295	0.4592%		0.0991024	0.2577%		0.0556039	0.1446%		0.031198	0.0811%		0.0175044	0.0455%		15.3559%	0.3993%
1.0266		0.5592161	1.4886%		0.3127227	0.8325%		0.1748796	0.4655%		0.0977955	0.2603%		0.0546888	0.1456%		0.0305829	0.0814%	1.0266	0.0171024	0.0455%		15.2115%	0.4049%
1.0280		0.5550705	1.5542%		0.3081033	0.8627%		0.171019	0.4789%		0.0949276	0.2658%		0.0526915	0.1475%		0.0292475	0.0819%		0.0162344	0.0455%		14.8935%	0.417%
1.0290		0.5520633	1.601%		0.3047739	0.8838%		0.1682545	0.4879%		0.0928871	0.2694%		0.0512796	0.1487%		0.0283096	0.0821%		0.0156287	0.0453%		14.6660%	0.4253%
1.0300		0.5490531	1.6472%		0.3014594	0.9044%		0.1655172	0.4966%		0.0908777	0.2726%		0.0498967	0.1497%	1.03	0.0273959	0.0822%		0.0150418	0.0451%		14.4410%	0.4332%
1.0310		0.5460402	1.6927%		0.2981598	0.9243%		0.1628072	0.5047%		0.0888993	0.2756%		0.0485426	0.1505%		0.0265062	0.0822%		0.0144734	0.0449%		14.2184%	0.4408%
1.0320		0.5430245	1.7377%		0.2948756	0.9436%		0.1601247	0.5124%		0.0869516	0.2782%		0.0472169	0.1511%		0.0256399	0.082%		0.0139231	0.0446%		13.9984%	0.4479%
1.0330		0.5400064	1.782%		0.2916069	0.9623%		0.1574696	0.5196%		0.0850346	0.2806%		0.0459192	0.1515%		0.0247967	0.0818%		0.0133904	0.0442%		13.7807%	0.4548%
1.0340		0.5369859	1.8258%		0.2883539	0.9804%		0.154842	0.5265%		0.083148	0.2827%		0.0446493	0.1518%		0.023976	0.0815%		0.0128748	0.0438%		13.5655%	0.4612%
1.0350		0.5339634	1.8689%		0.2851169	0.9979%		0.152242	0.5328%		0.0812916	0.2845%	1.035	0.0434068	0.1519%		0.0231776	0.0811%		0.012376	0.0433%		13.3528%	0.4673%
1.0360		0.5309388	1.9114%		0.2818961	1.0148%		0.1496696	0.5388%		0.0794654	0.2861%		0.0421913	0.1519%		0.022401	0.0806%		0.0118936	0.0428%		13.1425%	0.4731%
1.0370		0.5279125	1.9533%		0.2786916	1.0312%		0.1471248	0.5444%		0.077669	0.2874%		0.0410025	0.1517%		0.0216457	0.0801%		0.011427	0.0423%		12.9346%	0.4786%
1.0380		0.5248846	1.9946%		0.2755038	1.0469%		0.1446077	0.5495%		0.0759024	0.2884%		0.03984	0.1514%		0.0209114	0.0795%		0.0109761	0.0417%		12.7291%	0.4837%
1.0390		0.5218552	2.0352%		0.2723329	1.0621%		0.1421183	0.5543%		0.0741652	0.2892%		0.0387035	0.1509%		0.0201976	0.0788%		0.0105402	0.0411%		12.5260%	0.4885%
1.0400		0.5188246	2.0753%		0.269179	1.0767%		0.1396567	0.5586%	1.04	0.0724573	0.2898%		0.0375926	0.1504%		0.019504	0.078%		0.0101191	0.0405%		12.3254%	0.493%
1.0500		0.4884874	2.4424%		0.2386199	1.1931%		0.1165628	0.5828%		0.0569395	0.2847%		0.0278142	0.1391%		0.0135869	0.0679%		0.006637	0.0332%		10.4477%	0.5224%
1.0510		0.4854544	2.4758%		0.235666	1.2019%		0.1144051	0.5835%		0.0555385	0.2832%		0.0269614	0.1375%		0.0130885	0.0668%		0.0063539	0.0324%		10.2726%	0.5239%
1.0520		0.4824223	2.5086%		0.2327313	1.2102%		0.1122748	0.5838%		0.0541639	0.2817%		0.0261299	0.1359%		0.0126056	0.0655%		0.0060812	0.0316%		10.0997%	0.5252%
1.0528		0.4800166	2.5342%		0.230416	1.2164%	1.0528	0.1106035	0.5839%		0.0530915	0.2803%		0.0254848	0.1345%		0.0122331	0.0646%		0.0058721	0.031%		9.9641%	0.526%
1.0540		0.4763613	2.5724%		0.2269201	1.2254%		0.108096	0.5837%		0.0514927	0.2781%		0.0245291	0.1325%		0.0116847	0.0631%		0.0055662	0.0301%		9.7607%	0.5271%
1.0550		0.4733328	2.6033%		0.2240439	1.2322%		0.1060473	0.5833%		0.0501957	0.2761%		0.0237593	0.1307%		0.011246	0.0619%		0.0053231	0.0293%		9.5945%	0.5277%
1.0560		0.4703058	2.6337%		0.2211875	1.2387%		0.1040258	0.5825%		0.0489239	0.274%		0.0230092	0.1289%		0.0108214	0.0606%		0.0050893	0.0285%		9.4305%	0.5281%
1.0570		0.4672805	2.6635%		0.2183511	1.2446%		0.1020312	0.5816%		0.0476772	0.2718%		0.0222786	0.127%		0.0104104	0.0593%		0.0048646	0.0277%		9.2686%	0.5283%
1.0575		0.4656535	2.6793%		0.2168332	1.2476%		0.1009691	0.581%		0.0470166	0.2705%		0.0218935	0.126%		0.0101948	0.0587%		0.0047472	0.0273%	1.0575381	9.1825%	0.5283%
1.0590		0.4612358	2.7213%		0.2127384	1.2552%		0.0981226	0.5789%		0.0452576	0.267%		0.0208744	0.1232%		0.009628	0.0568%		0.0044408	0.0262%		8.9514%	0.5281%
1.0600		0.4582167	2.7493%		0.2099625	1.2598%		0.0962083	0.5772%		0.0440843	0.2645%		0.0202001	0.1212%		0.009256	0.0555%		0.0042413	0.0254%		8.7960%	0.5278%
1.0700		0.4281865	2.9973%	1.07	0.1833437	1.2834%		0.0785053	0.5495%		0.0336149	0.2353%		0.0143934	0.1008%		0.0061631	0.0431%		0.0026389	0.0185%		7.3557%	0.5149%
1.0800		0.3985667	3.1885%		0.1588554	1.2708%		0.0633145	0.5065%		0.025235	0.2019%		0.0100578	0.0805%		0.0040087	0.0321%		0.0015977	0.0128%		6.1102%	0.4888%
1.0900		0.3695202	3.3257%		0.1365452	1.2289%		0.0504562	0.4541%		0.0186446	0.1678%		0.0068895	0.062%		0.0025458	0.0229%		0.0009407	0.0085%		5.0419%	0.4538%
1.0950		0.3552602	3.375%		0.1262098	1.199%		0.0448373	0.426%		0.0159289	0.1513%		0.0056589	0.0538%		0.0020104	0.0191%		0.0007142	0.0068%		4.5685%	0.434%
1.1000		0.3412001	3.412%		0.1164175	1.1642%		0.0397217	0.3972%		0.013553	0.1355%		0.0046243	0.0462%		0.0015778	0.0158%		0.0005383	0.0054%		4.1328%	0.4133%
1.1050		0.3273571	3.4372%		0.1071626	1.1252%		0.0350804	0.3683%		0.0114838	0.1206%		0.0037593	0.0395%		0.0012306	0.0129%		0.0004029	0.0042%		3.7324%	0.3919%
1.1100		0.3137475	3.4512%		0.0984375	1.0828%		0.0308845	0.3397%		0.0096899	0.1066%		0.0030402	0.0334%		0.0009539	0.0105%		0.0002993	0.0033%		3.3652%	0.3702%
1.1140	1.114	0.3029307	3.4546%		0.091767	1.0465%		0.027799	0.317%		0.0084212	0.096%		0.002551	0.0291%		0.0007728	0.0088%		0.0002341	0.0027%		3.0912%	0.3525%
1.1200		0.2872892	3.4475%		0.0825351	0.9904%		0.0237114	0.2845%		0.006812	0.0817%		0.001957	0.0235%		0.0005622	0.0067%		0.0001615	0.0019%		2.7220%	0.3266%
1.1250		0.2744684	3.4309%		0.0753329	0.9417%		0.0206765	0.2585%		0.005675	0.0709%		0.0015576	0.0195%		0.0004275	0.0053%		0.0001173	0.0015%		2.4419%	0.3052%
1.1300		0.2619364	3.4052%		0.0686107	0.8919%		0.0179716	0.2336%		0.0047074	0.0612%		0.001233	0.016%		0.000323	0.0042%		8.46E-05	0.0011%		2.1870%	0.2843%
	FBC*	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**
	1.114	0.3029307	**3.4546%**	**1.0712**	0.1802236	**1.2837%**	**1.0528**	0.1106035	**0.5839%**	**1.0422**	0.0687856	**0.2903%**	**1.0353**	0.043086	**0.1519%**	**1.0303**	0.0271064	**0.0822%**	**1.0266**	0.017102	**0.0455%**			**0.00528341**
	1.0575	0.4656535	**2.6793%**	**1.0575**	0.2168332	**1.2476%**	**1.0575**	0.1009691	**0.5810%**	**1.0575**	0.0470166	**0.2705%**	**1.0575**	0.0218935	**0.1260%**	**1.0575**	0.0101948	**0.0587%**	**1.0575**	0.0047472	**0.0273%**	**1.0575381**	**0.0918246**	**0.5283%**

Gates' Model (Unknown number of opponents, N)

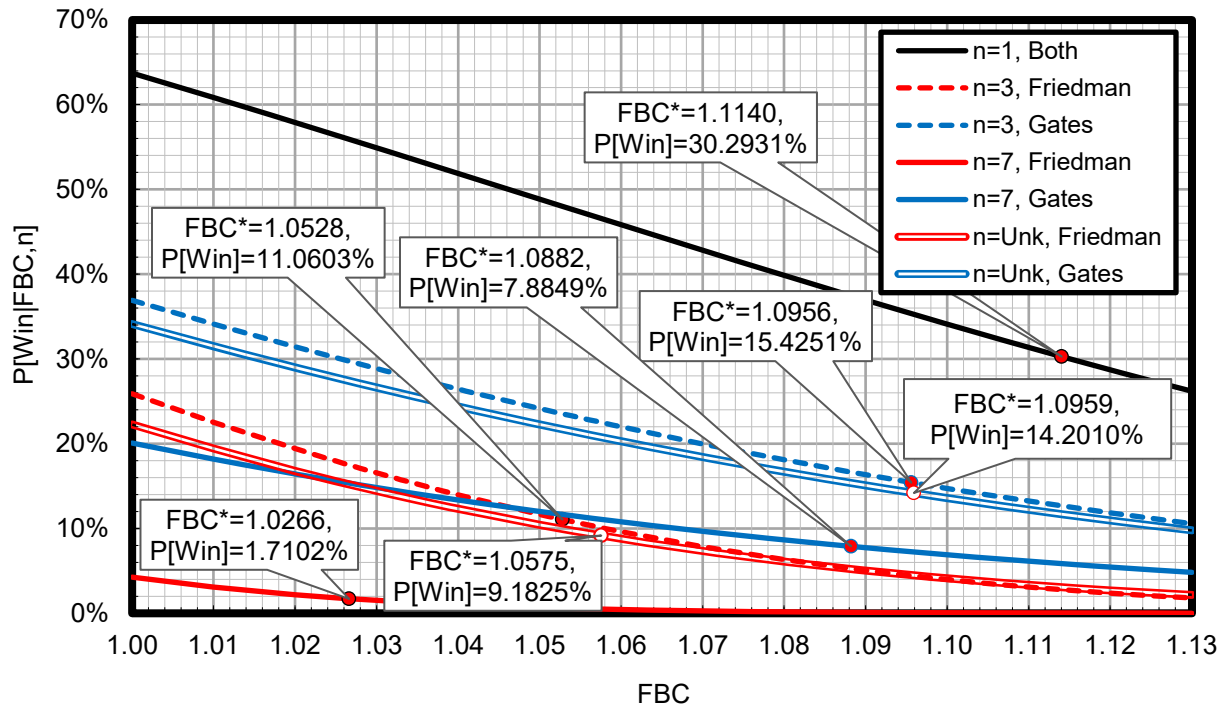
P[W|FBC] = 1/{1+nF(FBC)/[1-F(FBC)]}

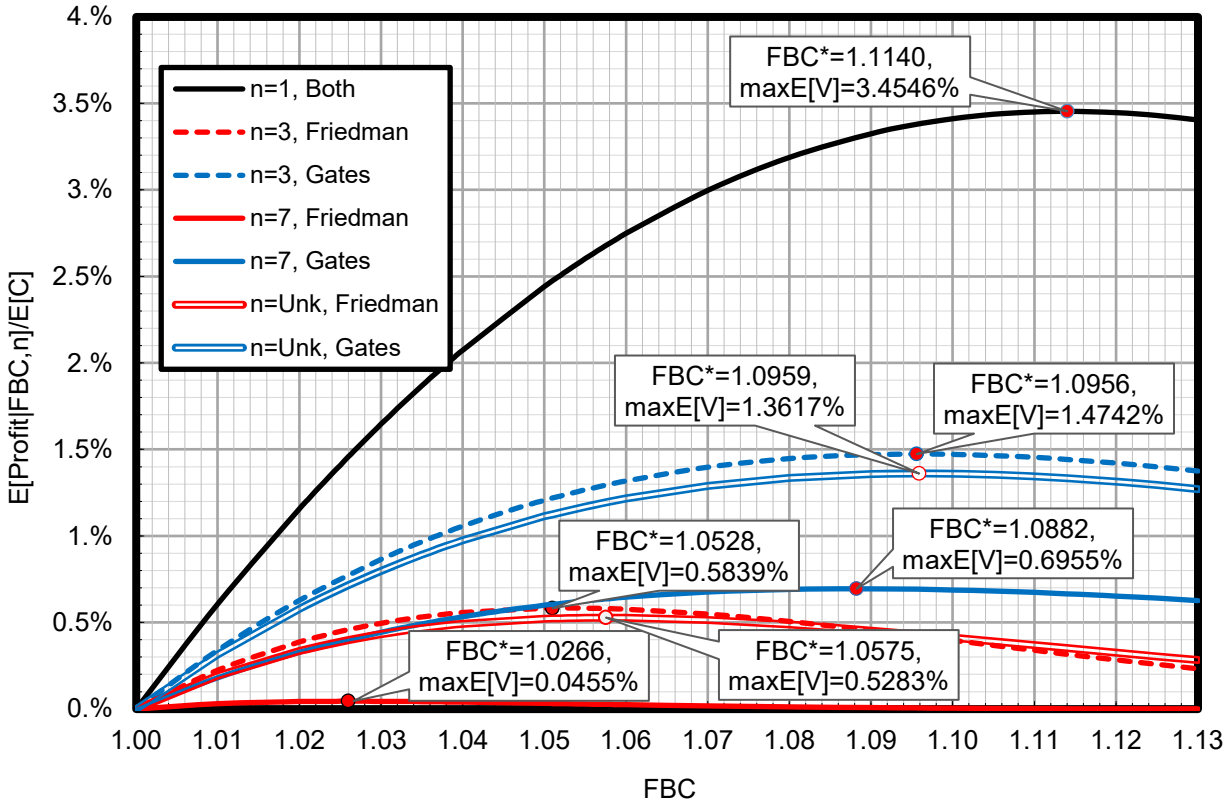
E[B/C] =	1.04620567
SD[B/C] =	0.13146538

The FBC* shown below for n=1,2,…,7, are for comparison only. They are not needed to compute FBC* when the number of opponents N is a random variable.

	P[N=n] = 6.67%			P[N=n] = 20.00%			P[N=n] = 16.67%			P[N=n] = 6.67%			P[N=n] = 10.00%			P[N=n] = 23.33%			P[N=n] = 16.67%			P[N=n] = 100.00%		
	n = 1			n = 2			n = 3			n = 4			n = 5			n = 6			n = 7			N is a random variable		
FBC	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]	FBC*	P[W]	E[Profit]
1.0000		0.6373808	0.%		0.4677615	0.%		0.369445	0.%		0.3052798	0.%		0.2601048	0.%		0.2265763	0.%		0.2007046	0.%		34.1311%	0.%
1.0100		0.6084958	0.6085%		0.4372936	0.4373%		0.3412748	0.3413%		0.2798309	0.2798%		0.2371363	0.2371%		0.2057452	0.2057%		0.1816934	0.1817%		31.5066%	0.3151%
1.0200		0.5789997	1.158%		0.4074592	0.8149%		0.314332	0.6287%		0.2558548	0.5117%		0.2157226	0.4314%		0.1864732	0.3729%		0.1642086	0.3284%		29.0054%	0.5801%
1.0210		0.5760226	1.2096%		0.4045167	0.8495%		0.3117082	0.6546%		0.2535386	0.5324%		0.2136654	0.4487%		0.1846293	0.3877%		0.1625408	0.3413%		28.7623%	0.604%
1.0220		0.5730411	1.2607%		0.4015821	0.8835%		0.3090974	0.68%		0.2512372	0.5527%		0.2116233	0.4656%		0.1828002	0.4022%		0.1608874	0.354%		28.5204%	0.6274%
1.0230		0.5700555	1.3111%		0.3986557	0.9169%		0.3064997	0.7049%		0.2489506	0.5726%		0.2095963	0.4821%		0.1809859	0.4163%		0.1592482	0.3663%		28.2798%	0.6504%
1.0240		0.5670658	1.361%		0.3957375	0.9498%		0.3039153	0.7294%		0.2466788	0.592%		0.2075844	0.4982%		0.1791864	0.43%		0.1576232	0.3783%		28.0405%	0.673%
1.0250		0.5640723	1.4102%		0.3928278	0.9821%		0.301344	0.7534%		0.2444217	0.6111%		0.2055874	0.514%		0.1774014	0.4435%		0.1560122	0.39%		27.8025%	0.6951%
1.0260		0.5610752	1.4588%		0.3899267	1.0138%		0.298786	0.7768%		0.2421795	0.6297%		0.2036054	0.5294%		0.175631	0.4566%		0.1544152	0.4015%		27.5657%	0.7167%
1.0266		0.5592161	1.4886%		0.3881333	1.0332%		0.2972076	0.7912%		0.2407974	0.641%		0.2023846	0.5387%		0.1745413	0.4646%		0.1534326	0.4084%		27.4197%	0.7299%
1.0280		0.5550705	1.5542%		0.3841506	1.0756%		0.29371	0.8224%		0.2377391	0.6657%		0.1996859	0.5591%		0.1721337	0.482%		0.1512628	0.4235%		27.0961%	0.7587%
1.0290		0.5520633	1.601%		0.3812759	1.1057%		0.2911921	0.8445%		0.235541	0.6831%		0.1977484	0.5735%		0.1704066	0.4942%		0.1497072	0.4342%		26.8633%	0.779%
1.0300		0.5490531	1.6472%		0.3784102	1.1352%		0.2886876	0.8661%		0.2333576	0.7001%		0.1958255	0.5875%		0.1686937	0.5061%		0.1481652	0.4445%		26.6317%	0.799%
1.0310		0.5460402	1.6927%		0.3755538	1.1642%		0.2861966	0.8872%		0.2311888	0.7167%		0.1939174	0.6011%		0.166995	0.5177%		0.1466368	0.4546%		26.4014%	0.8184%
1.0320		0.5430245	1.7377%		0.3727067	1.1927%		0.2837191	0.9079%		0.2290347	0.7329%		0.1920238	0.6145%		0.1653104	0.529%		0.1451218	0.4644%		26.1725%	0.8375%
1.0330		0.5400064	1.782%		0.369869	1.2206%		0.2812552	0.9281%		0.2268953	0.7488%		0.1901448	0.6275%		0.1636399	0.54%		0.1436202	0.4739%		25.9448%	0.8562%
1.0340		0.5369859	1.8258%		0.3670409	1.2479%		0.2788048	0.9479%		0.2247704	0.7642%		0.1882803	0.6402%		0.1619833	0.5507%		0.1421318	0.4832%		25.7184%	0.8744%
1.0350		0.5339634	1.8689%		0.3642224	1.2748%		0.2763681	0.9673%		0.2226601	0.7793%		0.1864302	0.6525%		0.1603405	0.5612%		0.1406566	0.4923%		25.4934%	0.8923%
1.0360		0.5309388	1.9114%		0.3614137	1.3011%		0.273945	0.9862%		0.2205643	0.794%		0.1845945	0.6645%		0.1587116	0.5714%		0.1391945	0.5011%		25.2696%	0.9097%
1.0370		0.5279125	1.9533%		0.3586149	1.3269%		0.2715355	1.0047%		0.2184831	0.8084%		0.1827731	0.6763%		0.1570964	0.5813%		0.1377454	0.5097%		25.0471%	0.9267%
1.0380		0.5248846	1.9946%		0.3558261	1.3521%		0.2691397	1.0227%		0.2164164	0.8224%		0.1809659	0.6877%		0.1554948	0.5909%		0.1363092	0.518%		24.8260%	0.9434%
1.0390		0.5218552	2.0352%		0.3530475	1.3769%		0.2667577	1.0404%		0.2143641	0.836%		0.1791729	0.6988%		0.1539067	0.6002%		0.1348858	0.5261%		24.6061%	0.9596%
1.0400		0.5188246	2.0753%		0.350279	1.4011%		0.2643893	1.0576%		0.2123262	0.8493%		0.177394	0.7096%		0.1523322	0.6093%		0.1334751	0.5339%		24.3876%	0.9755%
1.0500		0.4884874	2.4424%		0.3231779	1.6159%		0.2414638	1.2073%		0.1927323	0.9637%		0.1603675	0.8018%		0.1373096	0.6865%		0.1200487	0.6002%		22.2738%	1.1137%
1.0510		0.4854544	2.4758%		0.3205281	1.6347%		0.2392472	1.2202%		0.1908505	0.9733%		0.1587395	0.8096%		0.1358778	0.693%		0.1187722	0.6057%		22.0696%	1.1255%
1.0520		0.4824223	2.5086%		0.3178897	1.653%		0.2370445	1.2326%		0.1889827	0.9827%		0.1571249	0.817%		0.1344586	0.6992%		0.1175073	0.611%		21.8667%	1.1371%
1.0528		0.4800166	2.5342%		0.3158039	1.6672%		0.2353061	1.2423%		0.1875101	0.9899%		0.1558529	0.8228%		0.133341	0.704%		0.1165117	0.6151%		21.7065%	1.146%
1.0540		0.4763613	2.5724%		0.3126472	1.6883%		0.2326804	1.2565%		0.1852886	1.0006%		0.1539353	0.8313%		0.1316572	0.7109%		0.1150122	0.6211%		21.4647%	1.1591%
1.0550		0.4733328	2.6033%		0.3100432	1.7052%		0.2305191	1.2679%		0.1834622	1.009%		0.1523602	0.838%		0.130275	0.7165%		0.1137818	0.6258%		21.2656%	1.1696%
1.0560		0.4703058	2.6337%		0.3074509	1.7217%		0.2283716	1.2789%		0.1816496	1.0172%		0.1507982	0.8445%		0.1289049	0.7219%		0.1125628	0.6304%		21.0679%	1.1798%
1.0570		0.4672805	2.6635%		0.3048702	1.7378%		0.2262379	1.2896%		0.1798507	1.0251%		0.149249	0.8507%		0.1275469	0.727%		0.1113549	0.6347%		20.8714%	1.1897%
1.0580		0.4642571	2.6927%		0.3023013	1.7533%		0.2241179	1.2999%		0.1780654	1.0328%		0.1477128	0.8567%		0.1262009	0.732%		0.1101582	0.6389%		20.6762%	1.1992%
1.0590		0.4612358	2.7213%		0.2997443	1.7685%		0.2220118	1.3099%		0.1762936	1.0401%		0.1461894	0.8625%		0.1248668	0.7367%		0.1089726	0.6429%		20.4823%	1.2085%
1.0600		0.4582167	2.7493%		0.2971991	1.7832%		0.2199194	1.3195%		0.1745355	1.0472%		0.1446787	0.8681%		0.1235446	0.7413%		0.1077979	0.6468%		20.2897%	1.2174%
1.0700		0.4281865	2.9973%		0.2724156	1.9069%		0.1997486	1.3982%		0.1576858	1.1038%		0.1302566	0.9118%		0.1109559	0.7767%		0.0966369	0.6765%		18.4335%	1.2903%
1.0800		0.3985667	3.1885%		0.2488812	1.991%		0.1809309	1.4474%		0.142127	1.137%		0.1170282	0.9362%		0.0994635	0.7957%		0.0864833	0.6919%		16.7026%	1.3362%
1.0900		0.3695202	3.3257%		0.2266328	2.0397%		0.1634351	1.4709%	1.09	0.127798	1.1502%	1.09	0.1049201	0.9443%	1.09	0.0889896	0.8009%	1.09	0.0772589	0.6953%		15.0934%	1.3584%
1.0959		0.3527427	3.3824%		0.2141394	2.0534%	1.0959	0.1537331	1.4741%		0.1199083	1.1498%		0.0982836	0.9424%		0.083267	0.7984%		0.0722309	0.6926%	1.0958899	14.2010%	1.3617%
1.1000		0.3412001	3.412%	1.1	0.2056909	2.0569%		0.1472213	1.4722%		0.1146352	1.1464%		0.0938601	0.9386%		0.0794597	0.7946%		0.0688903	0.6889%		13.6020%	1.3602%
1.1050		0.3273571	3.4372%		0.1957125	2.055%		0.1395809	1.4656%		0.1084708	1.1389%		0.0887009	0.9314%		0.0750266	0.7878%		0.0650052	0.6826%		12.8991%	1.3544%
1.1100		0.3137475	3.4512%		0.186062	2.0467%		0.1322431	1.4547%		0.1025735	1.1283%		0.0837775	0.9216%		0.0708032	0.7788%		0.0613086	0.6744%		12.2238%	1.3446%
1.1140	1.114	0.3029307	3.4546%		0.1785022	2.0356%		0.1265301	1.443%		0.0979975	1.1176%		0.0799653	0.9119%		0.0675379	0.7702%		0.0584536	0.6666%		11.6980%	1.334%
1.1200		0.2872892	3.4475%		0.1677395	2.0129%		0.1184492	1.4214%		0.0915478	1.0986%		0.0746042	0.8953%		0.062953	0.7554%		0.0544494	0.6534%		10.9540%	1.3145%
1.1250		0.2744684	3.4309%		0.1590631	1.9883%		0.1119793	1.3997%		0.0864033	1.08%		0.0703381	0.8792%		0.0593104	0.7414%		0.0512719	0.6409%		10.3582%	1.2948%
1.1300		0.2619364	3.4052%		0.1507059	1.9592%		0.1057847	1.3752%		0.0814937	1.0594%		0.0662752	0.8616%		0.0558462	0.726%		0.0482531	0.6273%		9.7876%	1.2724%
	FBC*	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**	**FBC***	**P[W|FBC*]**	**E[V|FBC*]**
	1.114	0.3029307	**3.4546%**	**1.101**	0.2035835	**2.0571%**	**1.0956**	0.1542505	**1.4742%**	**1.0925**	0.1243766	**1.1507%**	**1.0906**	0.1042671	**0.9443%**	**1.0892**	0.0897845	**0.8009%**	**1.0882**	0.0788488	**0.6955%**			
	1.0959	0.3527427	**3.3824%**	**1.0959**	0.2141394	**2.0534%**	**1.0959**	0.1537331	**1.4741%**	**1.0959**	0.1199083	**1.1498%**	**1.0959**	0.0982836	**0.9424%**	**1.0959**	0.083267	**0.7984%**	**1.0959**	0.0722309	**0.6926%**	**1.0958899**	**0.1420104**	**1.3617%**

Friedman and Gates Analysis based on Acorn's Historical Bid Data





Results of Bidding Strategies When Applied to the Source Bidding Data

Friedman (assumes that the number of opponents on each past project were known before bidding that project)

n	1	2	3	4	5	6	7	Total	
FBC* (use Solver)	1.114040503	1.07122674	1.05279365	1.04221009	1.03526172	1.030323	1.02662		
max E[V|FBC*]/c	3.4546%	1.2837%	0.5839%	0.2903%	0.1519%	0.0822%	0.0455%		
#Projects available	0	11	13	11	7	2	4	48	(a)
# Projects Won	0	3	6	6	3	1	1	20	(b)
ΣCost of Projects Won	$0	$497,686	$559,474	$866,362	$247,846	$136,775	$35,179	$2,343,322	(c)
Total Profit $ | FBC*	$0	$35,449	$29,537	$36,569	$8,739	$4,147	$936	$115,378	(d)
#Won x (FBC*-1)	0.%	21.368%	31.676%	25.326%	10.579%	3.032%	2.662%	94.64%	(e)

#Won/#Total	(b) / (a)	41.667%	=Winning rate ~= Probability to win
Profit/Project won ($)	(d) / (c)	4.924%	=Average Markup made on each project won (sensitive to $ size of projects won)
Profit/Project won (#)	(e) / (b)	4.732%	=Average Markup made on each project won (insensitive to $ size of projects won)

(e) = %Markup summed over all projects won

Gates (assumes that the number of opponents on each past project were known before bidding that project)

n	1	2	3	4	5	6	7	Total	
FBC* (use Solver)	1.114040503	1.10104241	1.09556888	1.0925178	1.09056572	1.089207	1.08821		
max E[V|FBC*]/c	3.4546%	2.0571%	1.4742%	1.1507%	0.9443%	0.8009%	0.6955%		
#Projects available	0	11	13	11	7	2	4	48	(a)
# Projects Won	0	2	3	4	2	0	1	12	(b)
ΣCost of Projects Won	$0	$490,929	$471,745	$838,745	$205,781	$0	$35,179	$2,042,379	(c)
Total Profit $ | FBC*	$0	$49,605	$45,084	$77,599	$18,637	$0	$3,103	$194,027	(d)
#Won x (FBC*-1)	0.%	20.208%	28.671%	37.007%	18.113%	0.%	8.821%	112.82%	(e)

#Won/#Total	(b) / (a)	25.00%	=Winning rate ~= Probability to win
Profit/Project won ($)	(d) / (c)	9.50%	=Average Markup made on each project won (sensitive to $ size of projects won)
Profit/Project won (#)	(e) / (b)	9.40%	=Average Markup made on each project won (insensitive to $ size of projects won)

(e) = %Markup summed over all projects won

Summary

	Brute Force	Brute Force	LBC ~ Normal	Friedman	Gates	
Criteria	FALSE	TRUE	TRUE	(<== use dBase formulas)		
FBC*	1.103537059	1.09516057	1.09055566	Varies	Varies	
ΣCost of Projects Won	$1,954,844	$2,049,136	$2,049,136	$2,343,322	$2,042,379	(c)
#Won	11	13	13	20	12	(b)
# Won/#Total	22.92%	27.08%	27.08%	41.67%	25.00%	(b) / (a)
Total $Profit over all	$202,399	$194,997	$185,561	$115,378	$194,027	(d)
Profit/Project won ($)	10.35%	9.52%	9.06%	4.92%	9.50%	(d) / (c)
#Won x (FBC*-1)	113.89%	123.71%	117.72%	94.64%	112.82%	(e)
Profit/Project won (#)	10.35%	9.52%	9.06%	4.73%	9.40%	(e) / (b)
ΣCost of Projects Won	$1,954,844	$2,049,136	$2,049,136	(<== use Array formulas)		