

Monte Carlo Simulation

The Art of Random Process Characterization

...just the color figures for those who got the B&W printed book...

D. James Benton

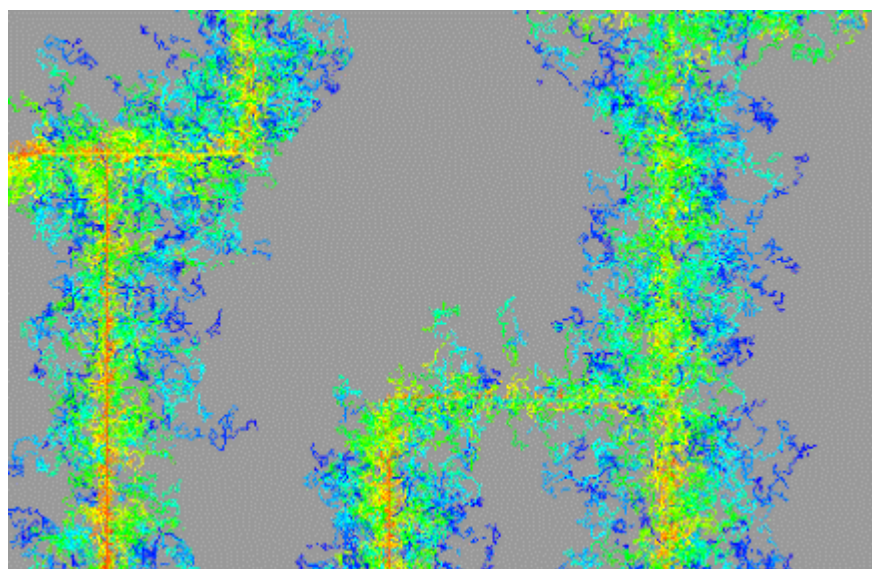
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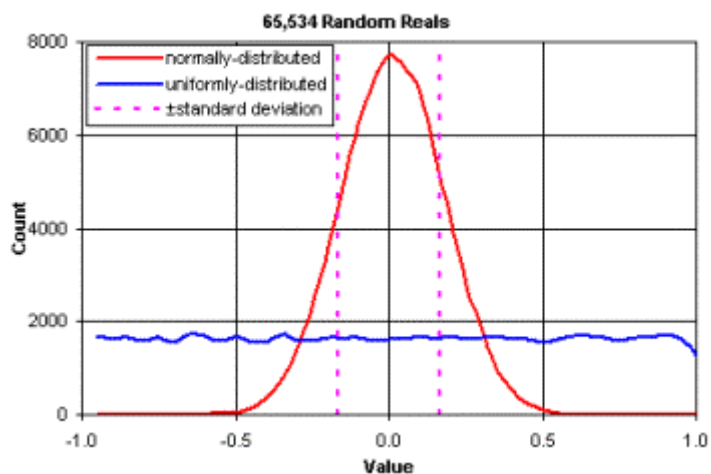
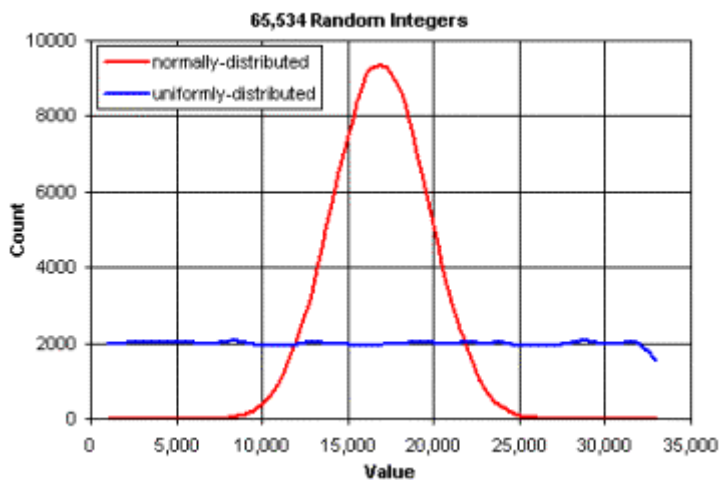
Foreword

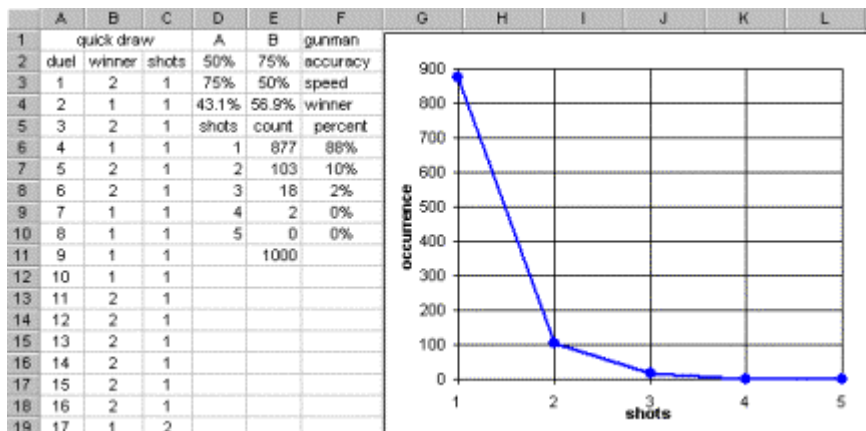
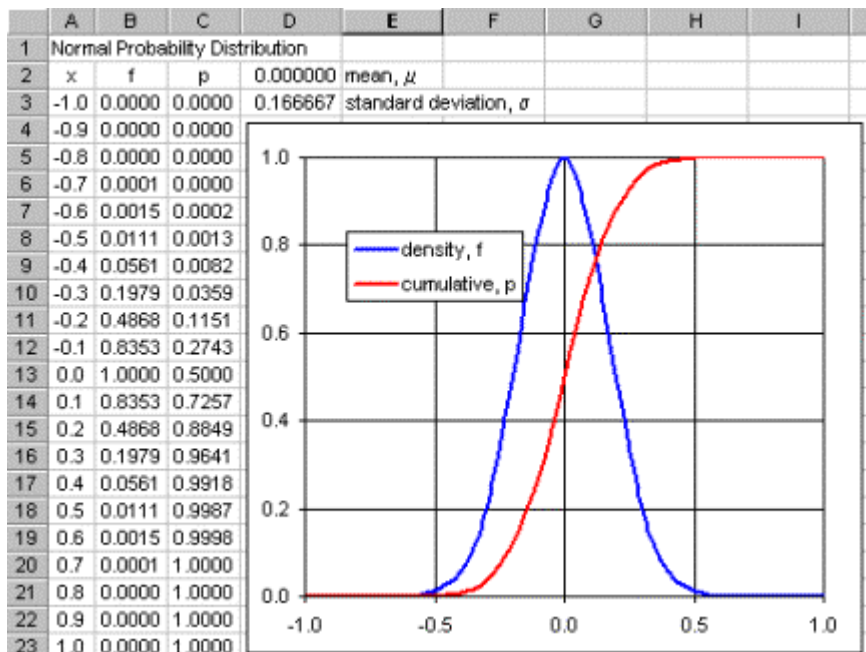
There are many textbooks devoted to the theory behind Monte Carlo methods. More often than not, these are heavy on theory and light on example. Rarely do they include the examples in their entirety, mostly presenting the final results in summary form. The aim of this text is to be light on theory and heavy on example. Each example is included in its entirety: input, output, and source code or spreadsheet. If you work through all the examples, you should be able to simulate whatever process is needed.

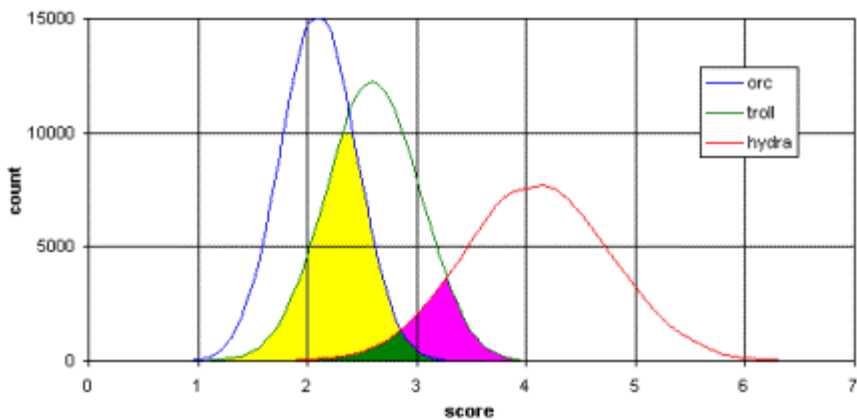
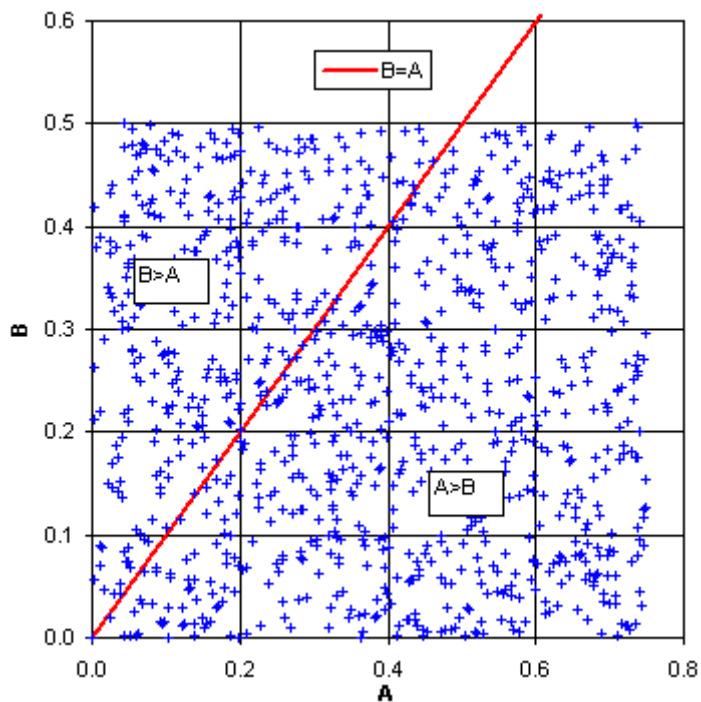
*All of the examples contained in this book,
(as well as a lot of free programs) are available at...*


<http://www.dudleybenton.altervista.org/software/index.html>

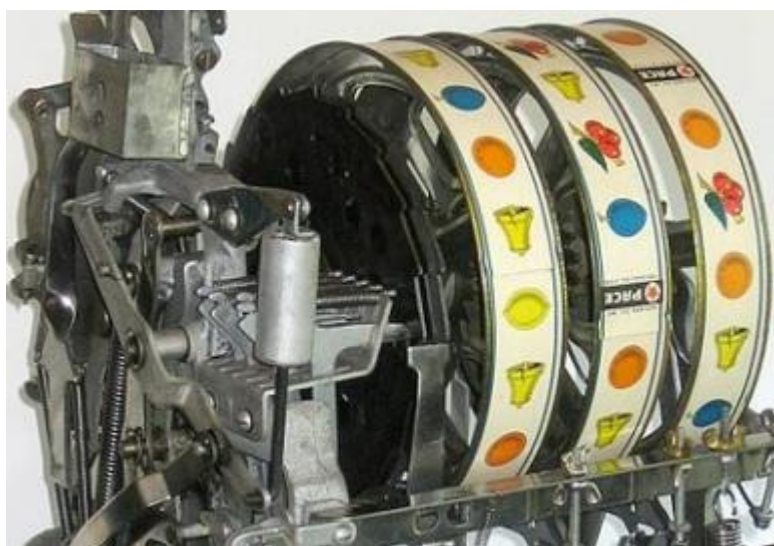


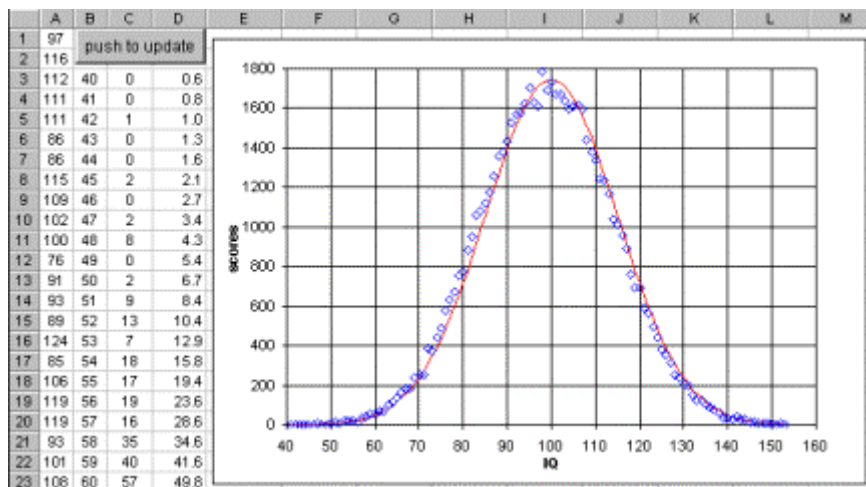
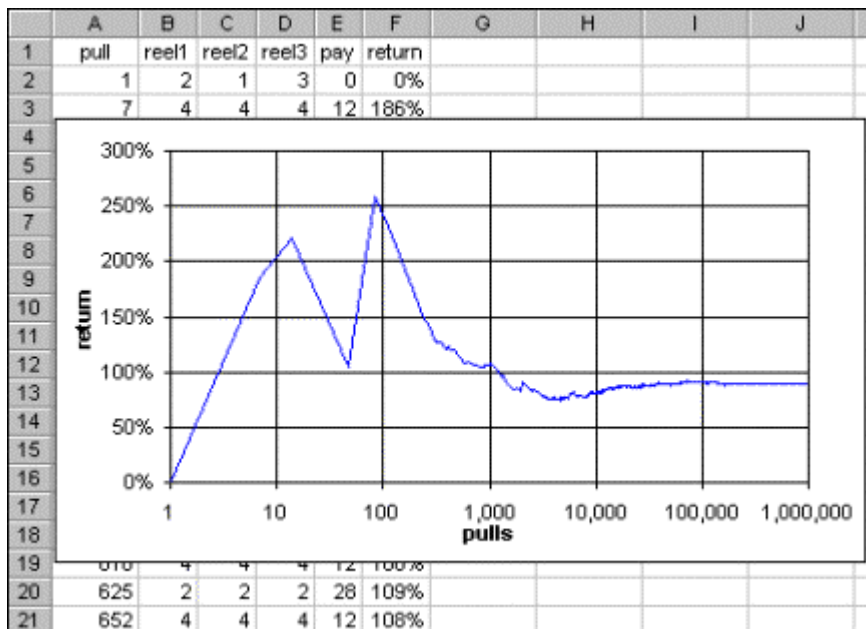




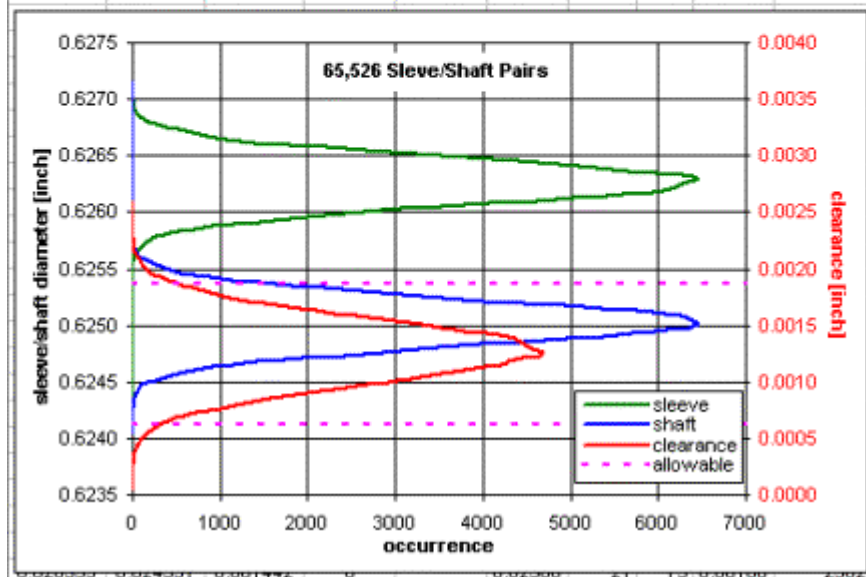


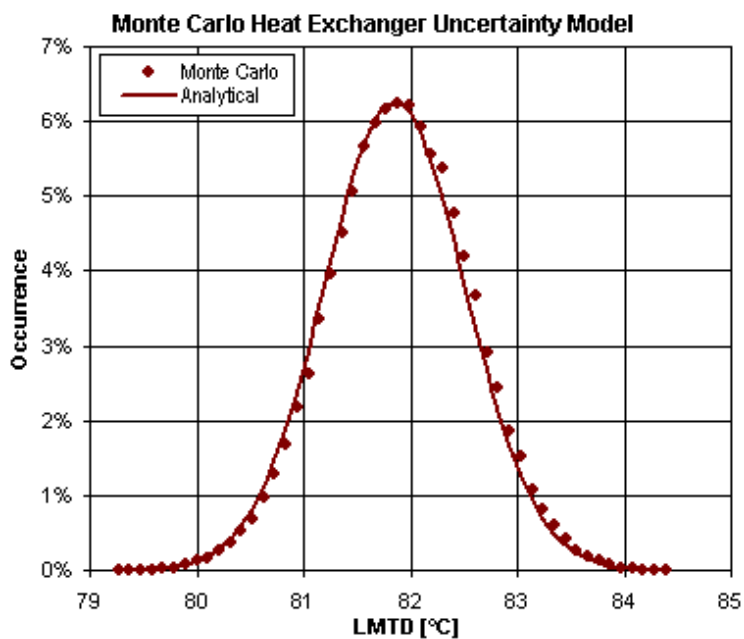
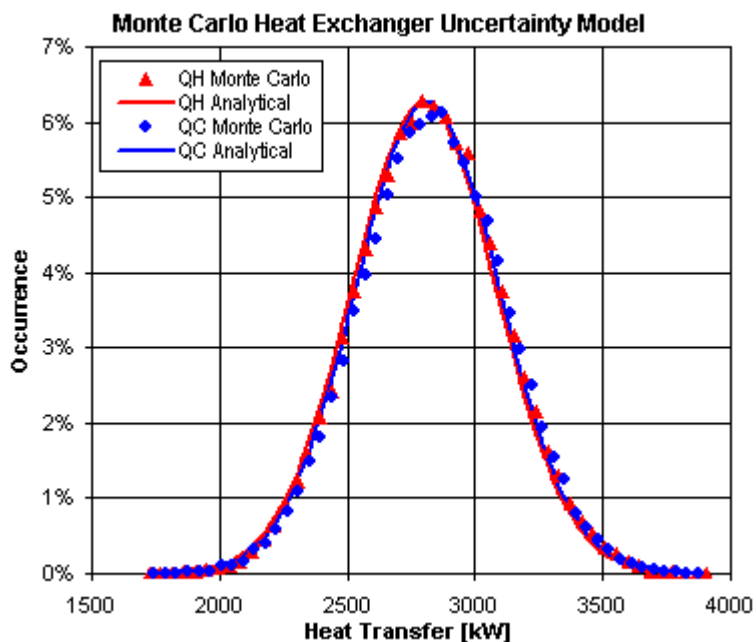
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1					1	2	3	4	6	12	18	18	odds*30	wheel		
2					35	17	11	8	5	2	1	1	payout	pos	val	clr
3					94.7%	94.7%	94.7%	94.7%	94.7%	94.7%	94.7%	94.7%	player	1	8	G
4					5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	house	2	28	B
5					94.7%	95.2%	94.6%	97.3%	97.3%	95.5%	94.0%	93.6%	simulation	3	9	R
6	spin	pos	val	clr	1	1,2	1,2,3	1,2,4,5	1-6	1-12	R	odd	bet	4	26	B
7	1	28	31	B	0	0	0	0	0	0	0	2		5	30	R
8	2	22	10	B	0	0	0	0	0	3	0	0		6	11	B
9	3	37	14	R	0	0	0	0	0	0	2	0		7	7	R
10	4	31	21	R	0	0	0	0	0	0	2	2		8	20	B
11	5	14	15	B	0	0	0	0	0	0	0	2		9	32	R
12	6	2	28	B	0	0	0	0	0	0	0	0		10	17	B
13	7	15	3	R	0	0	12	0	6	3	2	2		11	5	R
14	8	38	2	B	0	18	12	9	6	3	0	0		12	22	B



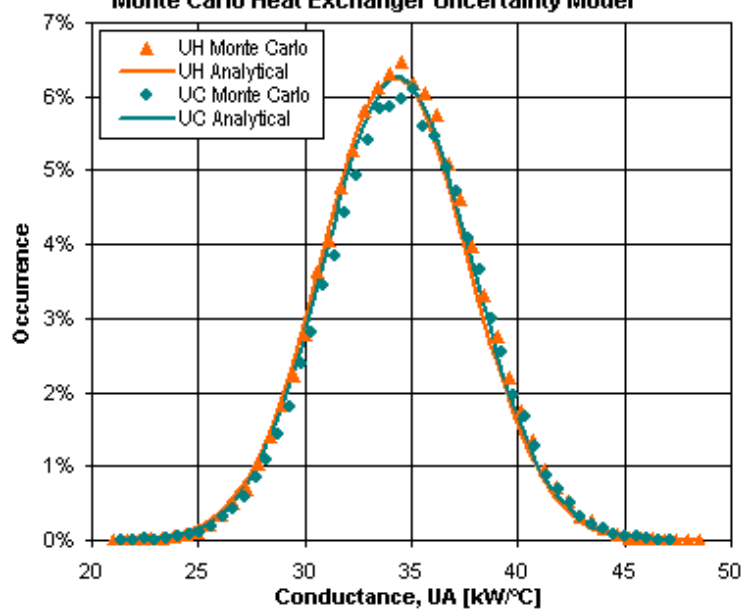


simulation parameters					0.62400	sleeve	shaft	0.00000	clearance	
0.626250	0.625000	0.001250	target		0.62405	0	0	0.00005	1	
0.000200	0.000200	0.000625	tolerance		0.62410	0	0	0.00010	0	
simulation summary results				allowable	0.62415	0	0	0.00015	0	
0.627039	0.625803	0.002340	max	0.001875	0.62420	0	0	0.00020	3	
0.626249	0.625001	0.001248	avg	0.001250	0.62425	0	1	0.00025	6	
0.625472	0.624246	-0.000011	min	0.000625	0.62430	0	11	0.00030	11	
0.000199	0.000200	0.000282	stdev		0.62435	0	20	0.00035	28	
simulation				1695	2.59%	0.62440	0	46	0.00040	38
sleeve	shaft	clearance	reject		0.62445	0	90	0.00045	63	
0.626513	0.624751	0.001762	0		0.62450	0	169	0.00050	103	

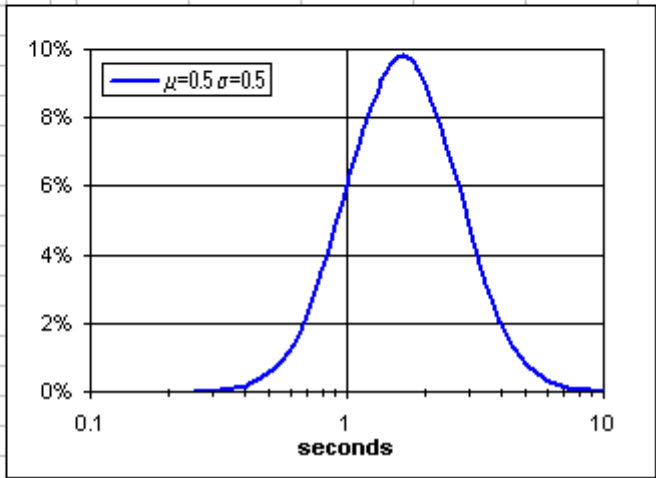
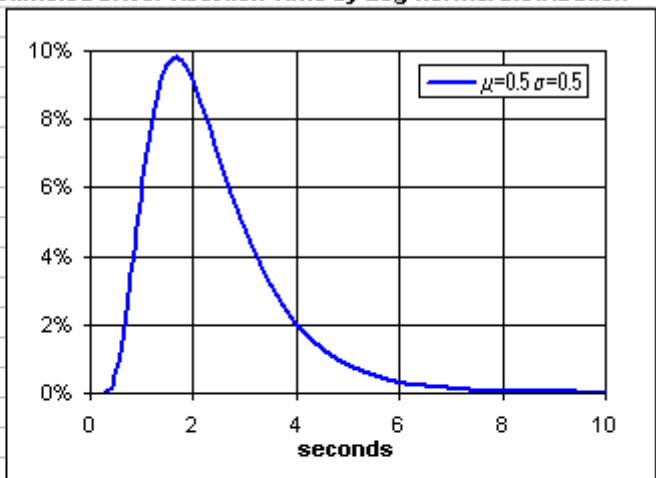




Monte Carlo Heat Exchanger Uncertainty Model

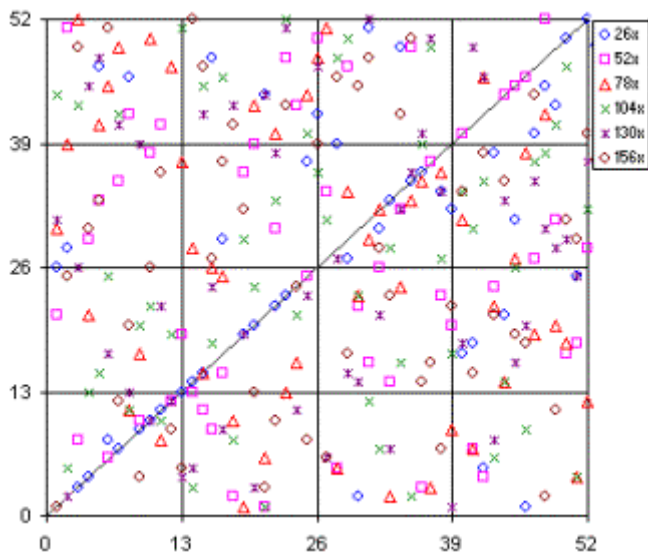
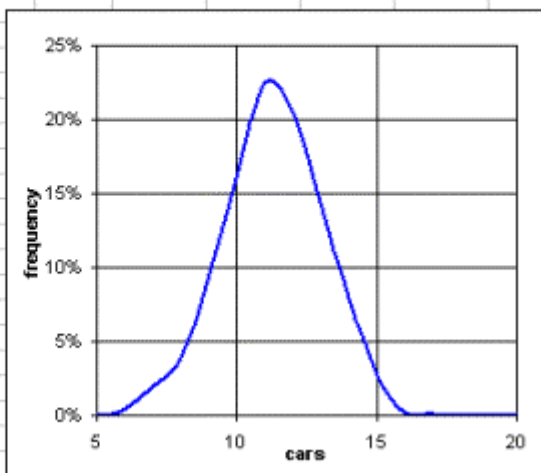


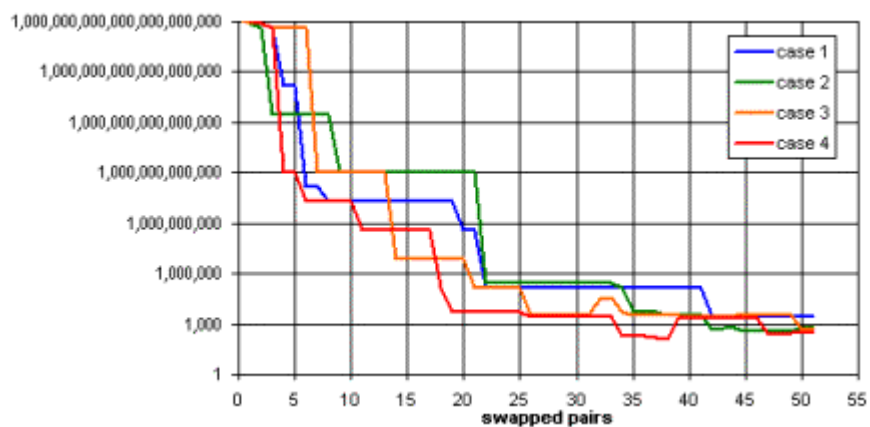
	A	B	C	D	E	F	G	H	I
1	Estimated Driver Reaction Time by Log-Normal Distribution								
2	time	freq							
3	0.250	0.01%							
4	0.283	0.02%							
5	0.320	0.05%							
6	0.362	0.10%							
7	0.409	0.20%							
8	0.462	0.39%							
9	0.523	0.70%							
10	0.591	1.20%							
11	0.669	1.92%							
12	0.756	2.91%							
13	0.855	4.14%							
14	0.967	5.55%							
15	1.09	7.00%							
16	1.24	8.31%							
17	1.40	9.29%							
18	1.58	9.78%							
19	1.79	9.68%							
20	2.02	9.03%							
21	2.29	7.92%							
22	2.59	6.54%							
23	2.92	5.09%							
24	3.31	3.72%							
25	3.74	2.57%							
26	4.23	1.66%							
27	4.78	1.02%							
28	5.41	0.58%							
29	6.11	0.32%							
30	6.92	0.16%							
31	7.82	0.08%							
32	8.84	0.03%							
33	10.0	0.01%							



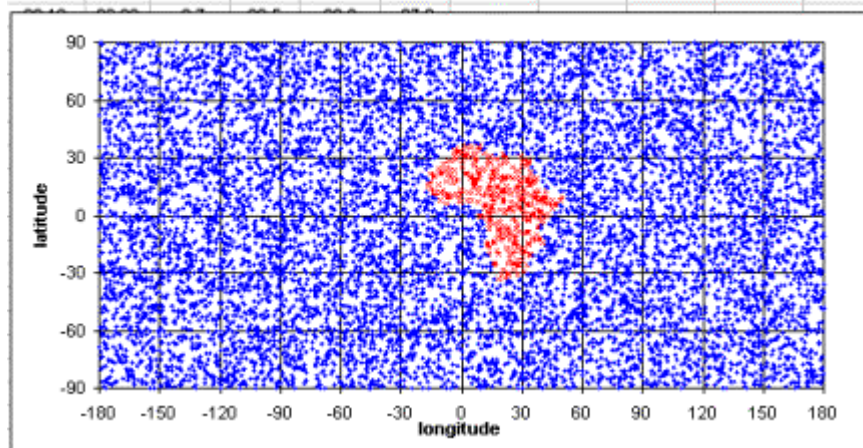
simplest traffic simulation

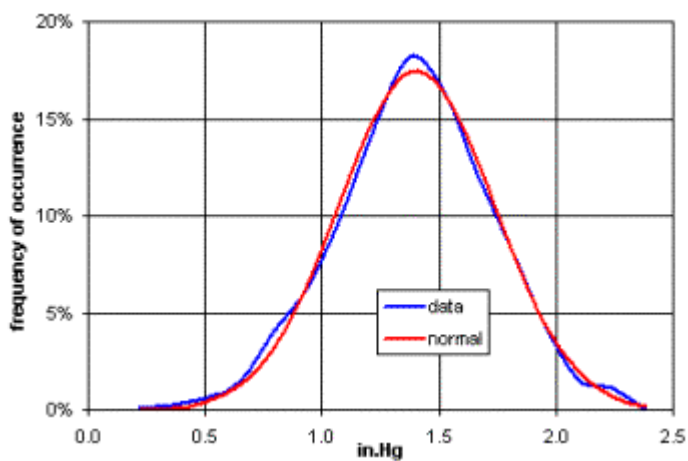
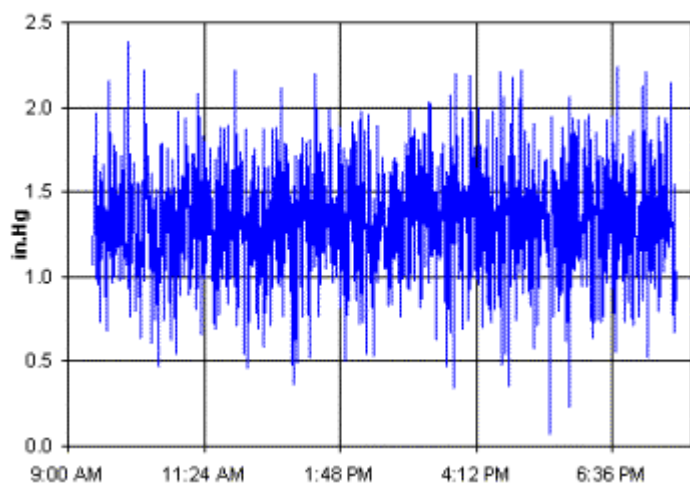
time	sum	cars	pass	count	freq	0.5 μ
1.51	1.51	9	0	0	0%	0.5 σ
1.65	3.16	10	1	0	0%	20 duration
3.57	6.73	11	2	0	0%	
1.29	8.02	10	3	0	0%	
1.98	10.00	10	4	0	0%	
1.22	11.22	11	5	0	0%	
1.12	12.35	11	6	4	0%	
1.79	14.14	10	7	19	2%	
0.85	14.99	13	8	39	4%	
1.54	16.53	8	9	96	10%	
1.50	18.04	9	10	160	16%	
1.06	19.10	11	11	225	23%	
1.89	20.99	8	12	204	20%	
1.75	22.73	12	13	144	14%	
1.89	24.63	13	14	79	8%	
2.23	26.86	12	15	27	3%	
1.35	28.21	12	16	2	0%	
1.56	29.78	12	17	1	0%	
2.23	32.01	9	18	0	0%	
0.93	32.94	11	19	0	0%	
		11	20	0	0%	

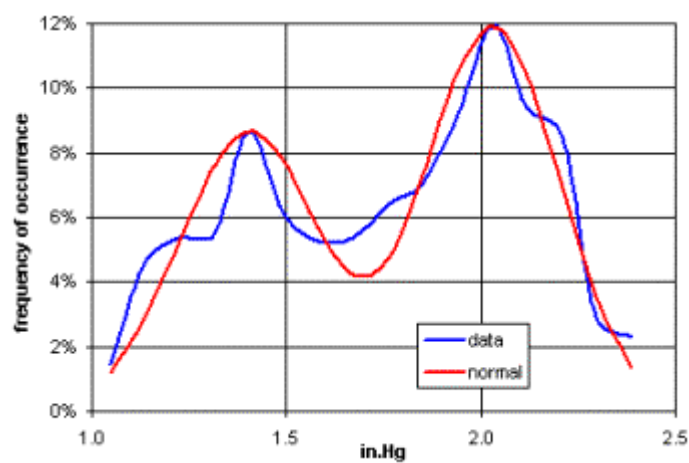
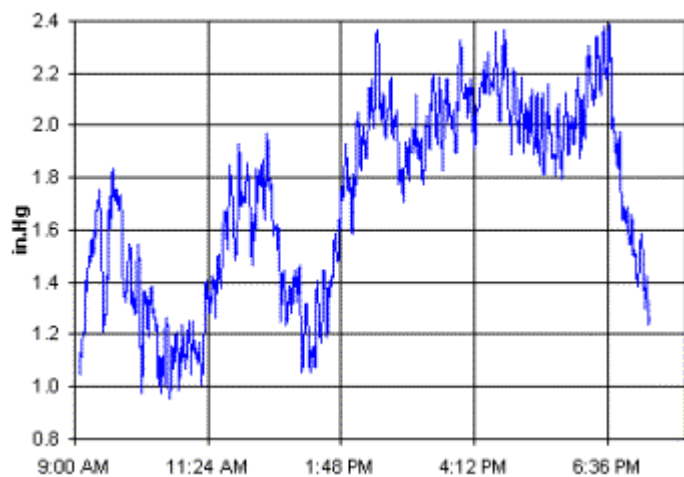


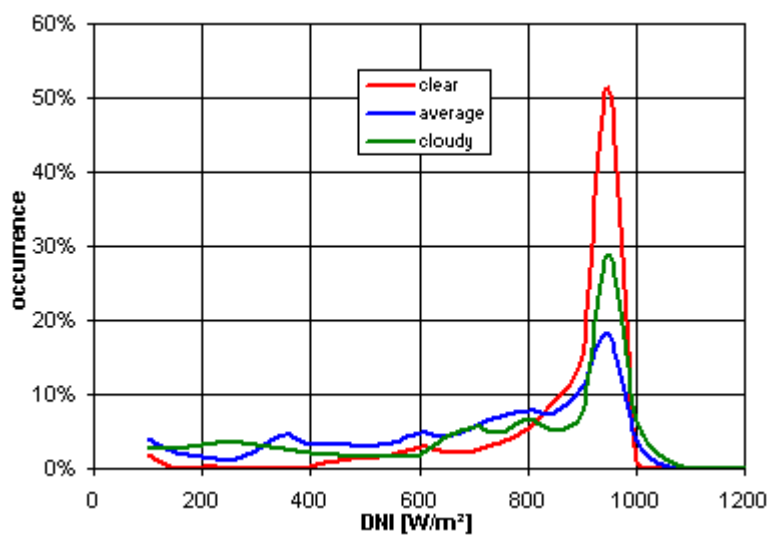
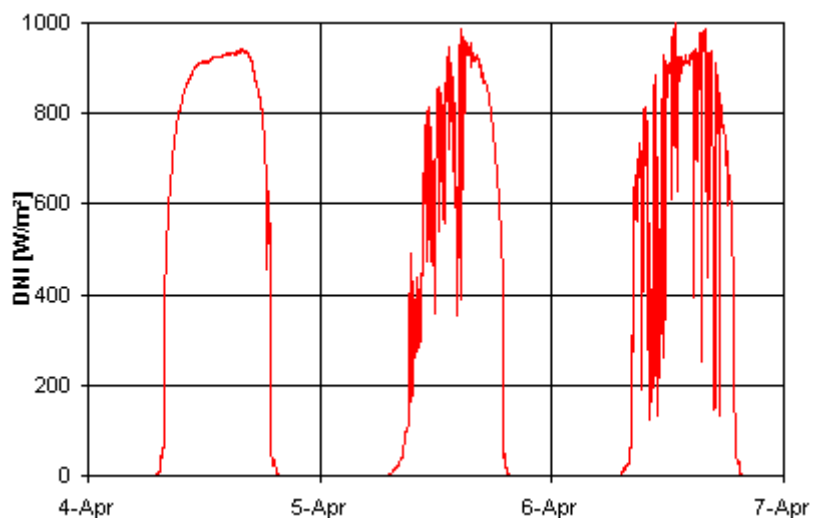


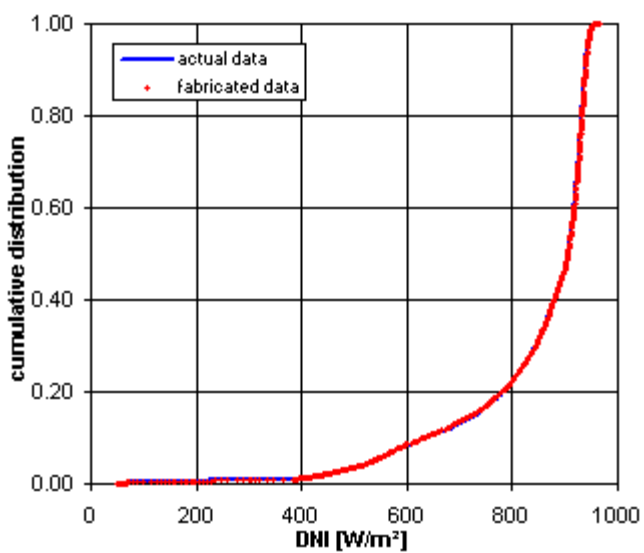
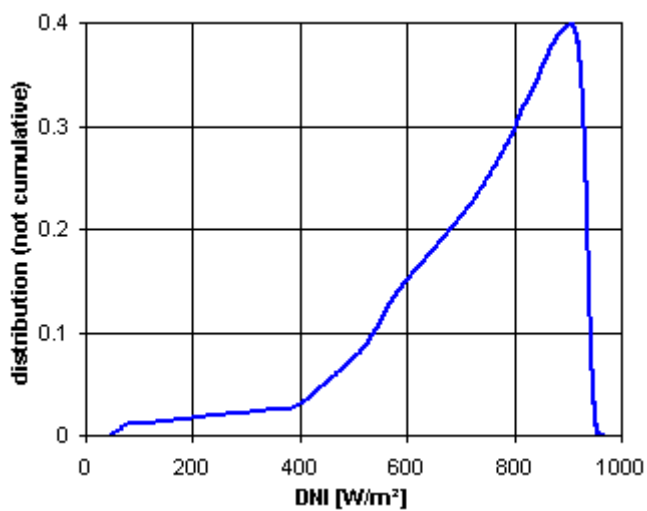
Africa		inside		outside		push to sample
longitude	latitude	longitude	latitude	longitude	latitude	
32.43	29.50	13.8	-16.8	74.0	6.0	



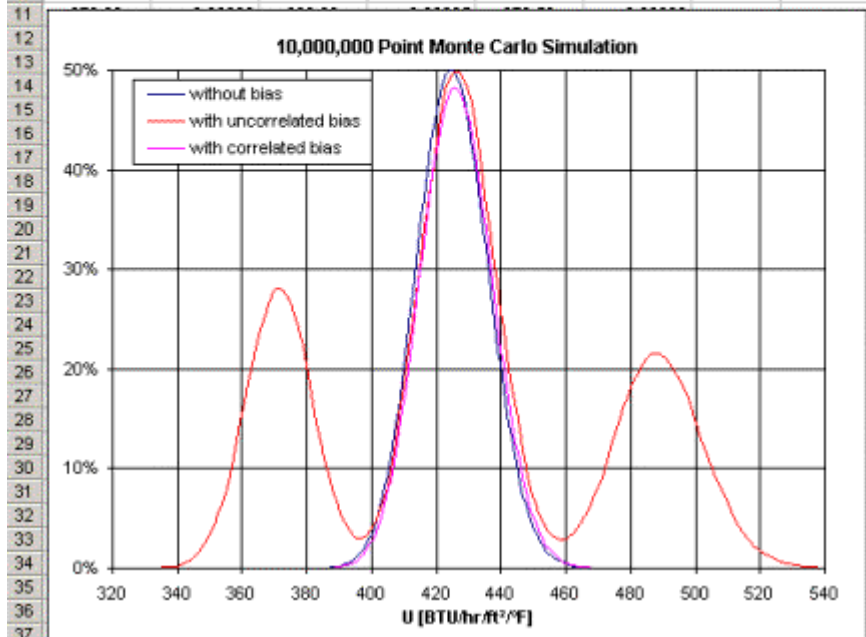


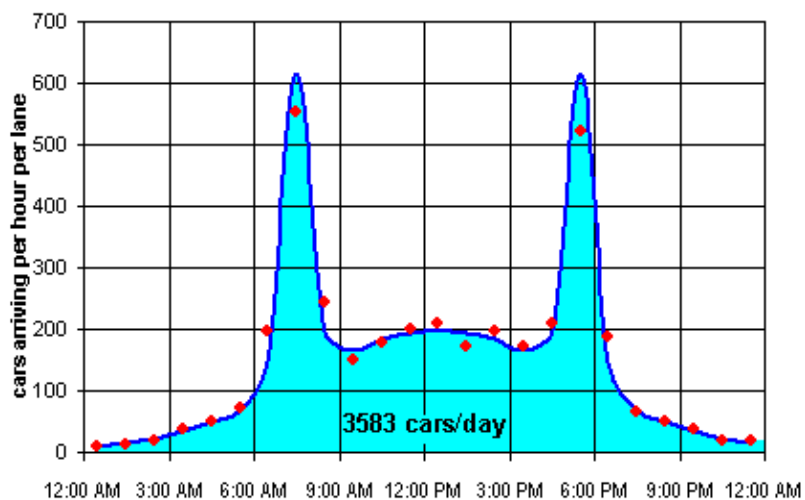
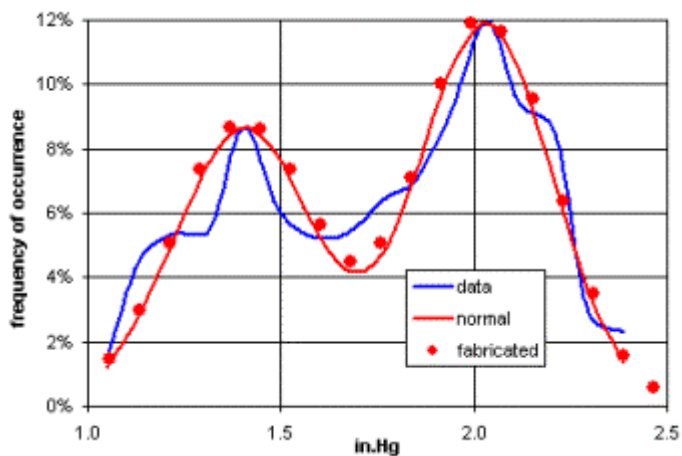


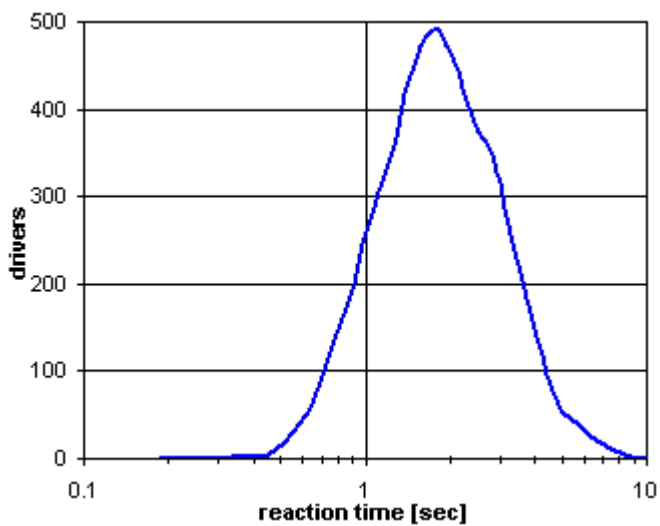
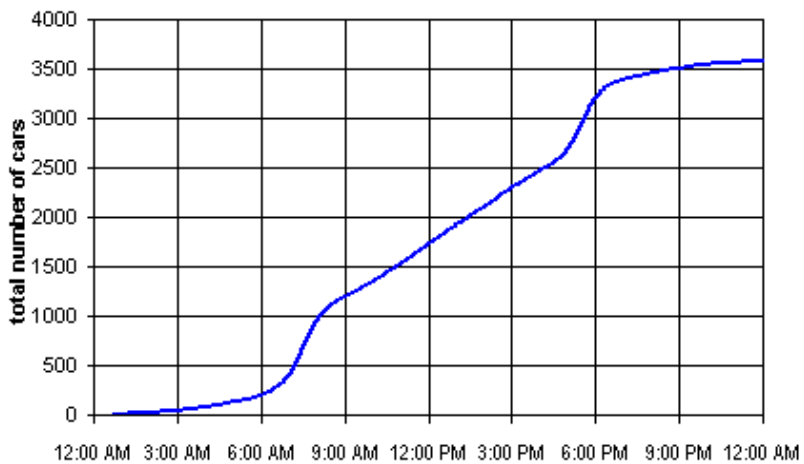


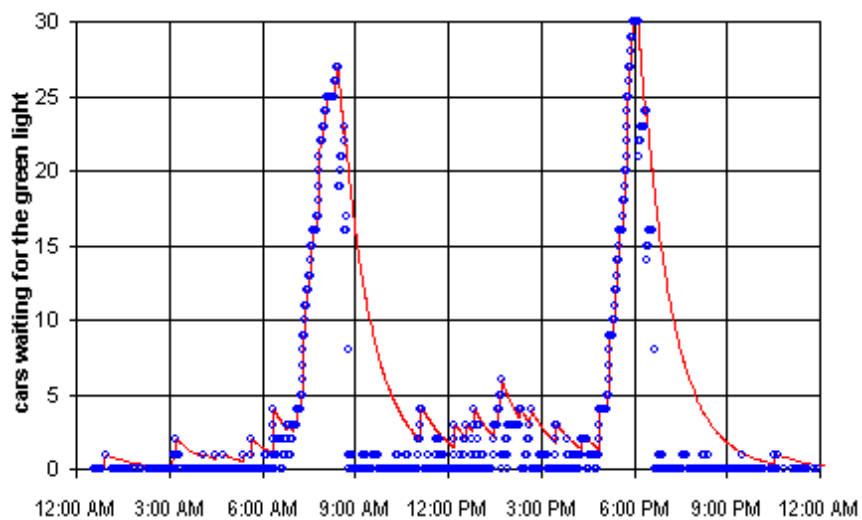


	A	B	C	D	E	F	G	H
1	10,000,000 Point Monte Carlo Simulation							
2	bias=F, correlated=F		bias=T, correlated=F		bias=T, correlated=T			
3	Umin=369.445		Umin=321.799		Umin=374.744			
4	Umean=425.628		Umean=429.614		Umean=426.793			
5	Umedian=426.753		Umedian=442.437		Umedian=430.299			
6	Umax=484.062		Umax=563.074		Umax=485.855			
7	U95=43.497 (10.2195%)		U95=149.86 (34.8824%)		U95=43.8323 (10.2701%)			
8	370.01	0.00000	322.98	0.00000	375.29	0.00000		
9	371.13	0.00000	325.35	0.00001	376.36	0.00000		
10	372.25	0.00000	327.71	0.00002	377.47	0.00001		

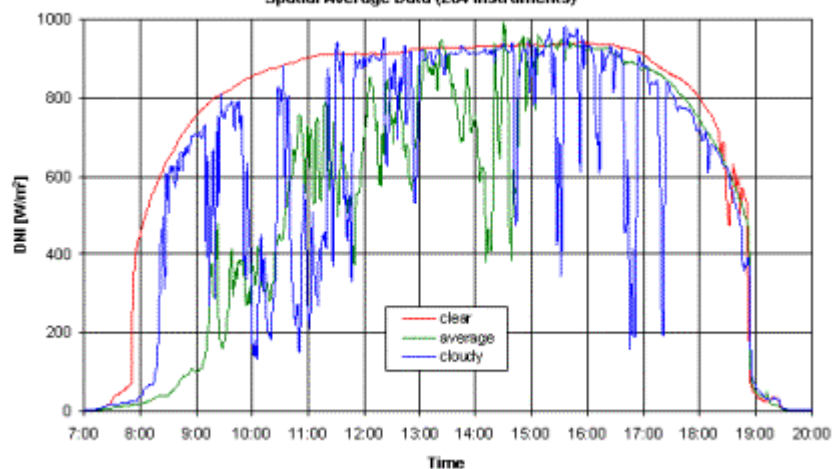








Spatial Average Data (284 instruments)



Typical Data (1 instrument)

