

Effective Bayesian Modelling with Knowledge before Data bayes-knowledge.com/

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aena



- BAYES-KNOWLEDGE is providing evidence-based decision-making in areas such as medicine, law, forensics, and transport. What makes it radical is that it does this in situations where there is little data, and hence where traditional statistics cannot be used.
- We bring together data, expert opinion, risk and uncertainty into a visual probabilistic framework, allowing decisionmakers to see their choices clearly.
- Instead of using confusing spreadsheets to model all the interactions between factors we use Bayesian networks (BNs) and we are developing novel strategies and new algorithms to extend and refine the use of BNs in decision-making.

Big Data ... or Smart Data?

X1 X2	X3	X4	X5 X	.6 X7	X8	Х9	X10	X11	X12)	X13 X1	14 X	15 X1	6 X17	X18	X19 X20	X21	X22	X23	X24	X25	X26 X27	Х	(28	
2.37767 Y	13.096	90.97012	5.125697	N 6	60.0658 69	9.21758	7 47.84372	29.7295	6.666544	95.24587 4	5.15552	9.048226	N 46.31	48 85.1510	2 9 85.788	33 4.45326	5 2.83035	5 78.0379	6 76.17417	1.847277	N 68	2829	60.36692	
7.662769 Y	14.9191	3 15.21648	9.945146	Y 75	6.86488 47	7.43799	34 68.94883	39.7349	0.696636	67.56639 8	0.85889	3.675565	Y 81.228	66 39.271	3 76 26.106	64 58.7175	2 7.151954	59.2965	9 85.26737	5.129726	Y 0.2	1902	2.161673	
3.488984 N	52.6310	6 89.41149	7.386725	N 28	8.76204 84	4.57343	11 28.81825	80.77848	1.200845	78.00696 8	9.37494	5.261092	N 56.832	33 38.5871	4 72 74.055	99 26.6204	2 2.307685	87.206	9 82.39348	4.22788	N 75.	5524	87.94973	machino loarning
9.81851 N	23.866	65.43775	4.360298	N 13	8.16775 71	1.68979	1 77.12818	56.19182	2.266462	92.25659 5	3.68782	1.599243	N 20.378	93 63.8282	5 18 36.726	03 21.5928	8 2.5667	12.8035	9 78.78243	3.990287	N 64.	3877	25.45127	
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2.151615 Y	35.1616	1.145642	0.83657	Y 34	.49611 26	6.52838	73 59.81372	54.44798	9.598353	17.66643 6	9.27065	4.670751	Y 81.339	31 86.8658	7 96 37.436	98.990	2 2.601628	31.7683	3 42.64539	7.200748	Y 73.	9475	77.26634	
7.421236 Y	63.2423	4 12.64985	8.784396	Y 89	9.41273 6.	655326	70 80.2798	18.40283	2.658364	90.74175 7	4.73187	2.371597	Y 74.33	44 83.8549	4 58 56.015	37 84.1382	5 3.488239	73.9917	5 86.26268	3 1.143448	Y 92	0597	86.91872	Second State
4.255776 N	70.1036	5 85.65778	3.020297	N 3	80.7728 46	6.44619	88 7.927662	51.44612	4.57583	51.83256 9	.769303	1.038895	N 87.713	71 25.9473	69 35.335	78 1.91099	2 6.878758	4.29769	6 90.85778	3 1.432747	N 98.	0912	73.42813	
4.599002 Y	84.2848	9 95.26785	8.992501	Y 41	.66895 8	88.5403	71 41.80412	98.052	2.40875	9.763891 2	4.07176	8.572444	Y 98.998	98 86.0545	5 98 47.799	48 91.1167	8 8.161812	4.23738	7 63.56331	0.265334	Y 37.	2946	57.78581	
5.090119 N	94.3393	1 20.51148	1.775828	Y 11	.13219 41	1.53141	42 77.62898	17.34269	9.43958	60.91525 1	8.33164	7.092703	Y 51.433	24 64.3243	3 91 18.606	71 6.02049	3 8.653948	80.4146	1 38.90216	9.222288	Y 72.	1006	9.068385	

What is a Bayesian Network?

A graphical model for representing causal or influential relationships between variables.



Some of our Bayesian network applications:

- More accurate and informative results of impact of forensic evidence like DNA [1, 3]
- Determine whether a prisoner is suitable for release based on the risk of serious reoffence [2]

Beating the bookies with more accurate predictions of Premier League football matches [4]



Bayesian Network Example: Which drug to recommend for particular disease?

Drug A: cheap and effective (mean financial) benefit \$4156)



Note: most people So obviously stop only have minor Patient condition 70% Minor using Drug B? case of the disease Moderate 🚽 20% Major - 10% No! Need to cost include hidden Drug used 82% variable *Patient* 18% condition – i.e. seriousness of the Financial benefit outcome (life prolonged more than 2 years) 0.012 disease. 0.00618.4% False-1800 1100 400.0 4600.0 3900.0 3200.0 2500.0 1000 81.6% True

So consider only patients with major case of the disease

Drug B: expensive and ineffective (mean financial benefit \$2777)



Drug A: Only 10% positive outcome,



Drug B: 30% positive outcome,



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