

Handling Uncertainty (& the flaw of averages)

Just give me a
number.... the
average will do!



The Flaw of Averages in Project Management

By Philip Fahringer, John Hinton, Marc Thibault, and Sam Savage

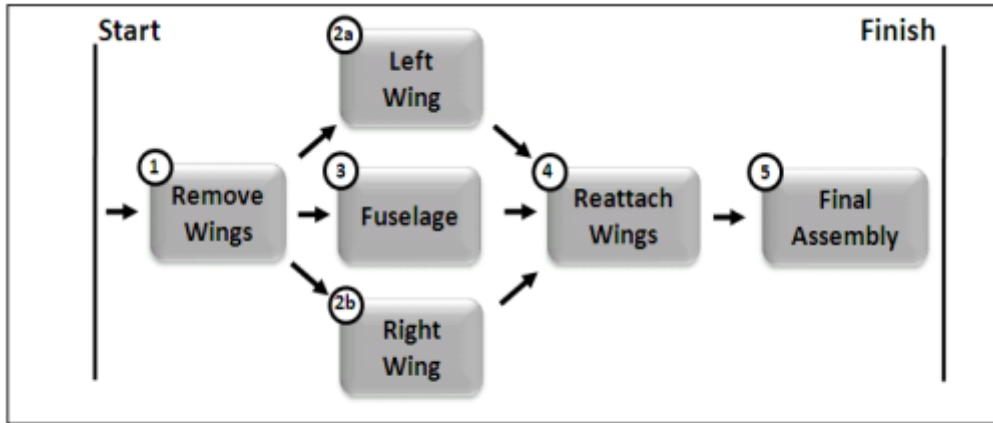


Figure 1: Dependency graph for refurbishing an aircraft.

The good news is that several years into the contract, the average task durations were roughly as initially predicted. The bad news was that the average time to complete each plane was significantly higher than anticipated—the firm lost millions of dollars, and four vice presidents lost their jobs.

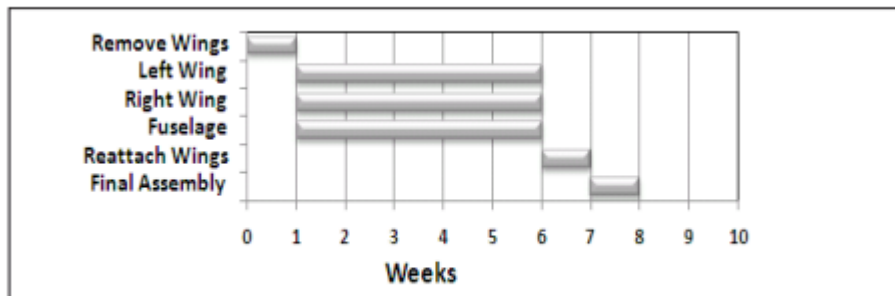
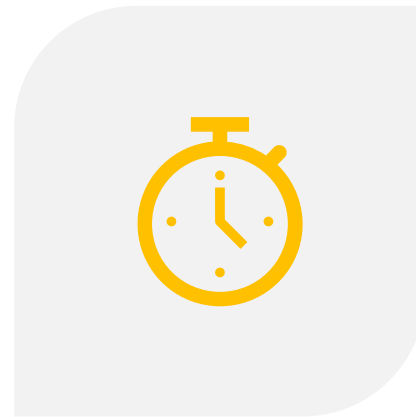


Figure 2: GANTT chart for refurbishing a plane.

Three toy scenarios



NUMBER OF BEDS ON A
DAY WARD



DURATION OF A PROJECT



MOBILE PHONE
INSURANCE

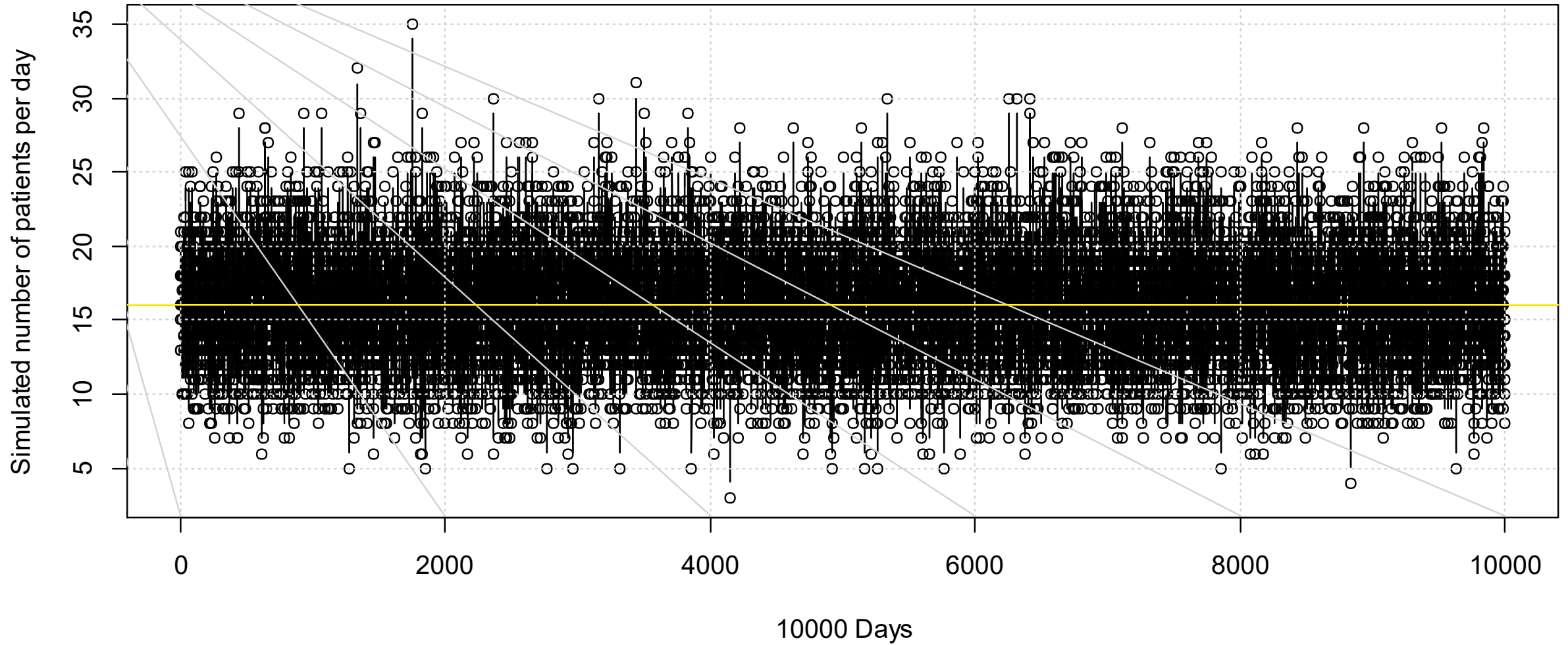


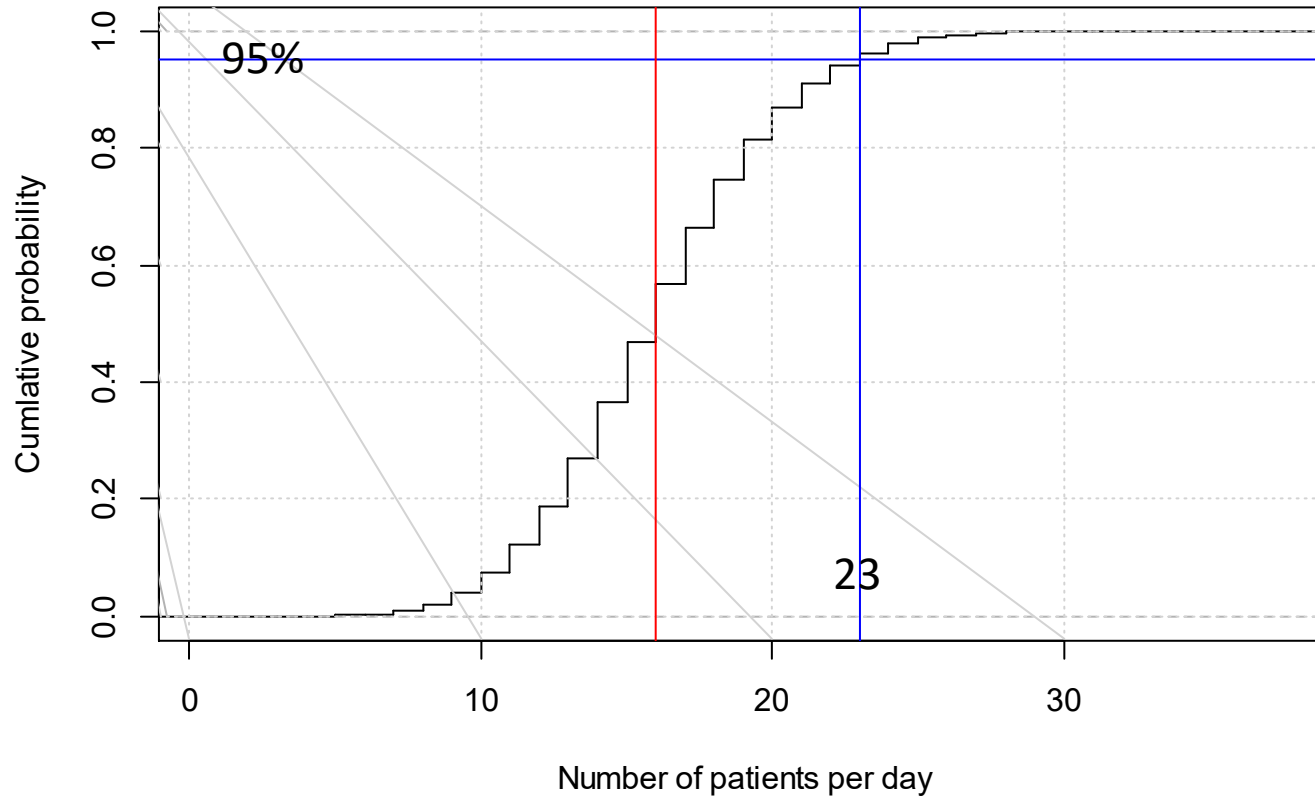
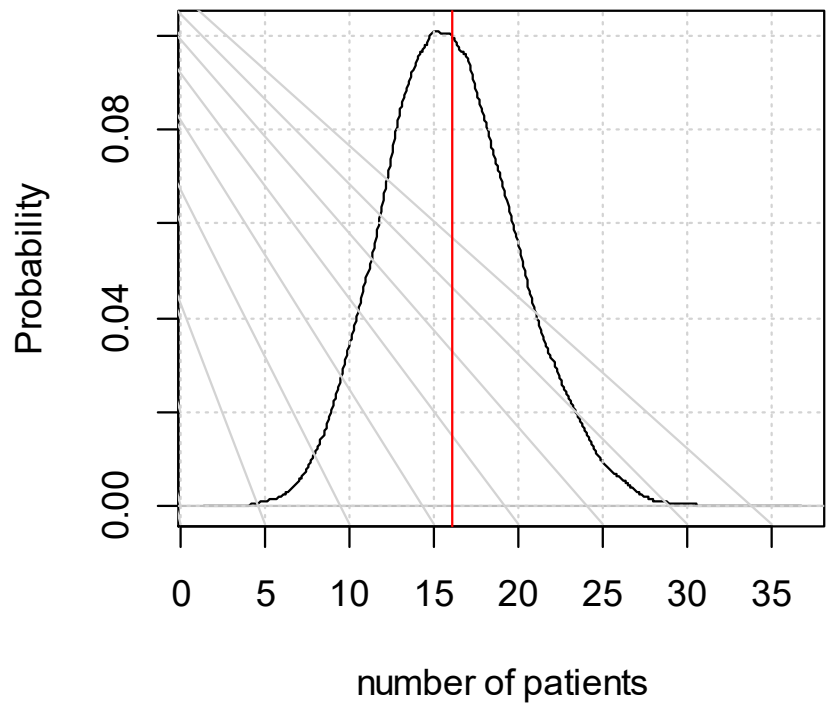
How many beds?

A day ward can expect to admit on average 16 patients per day.

How many beds are required to ensure a 95% service level agreement?

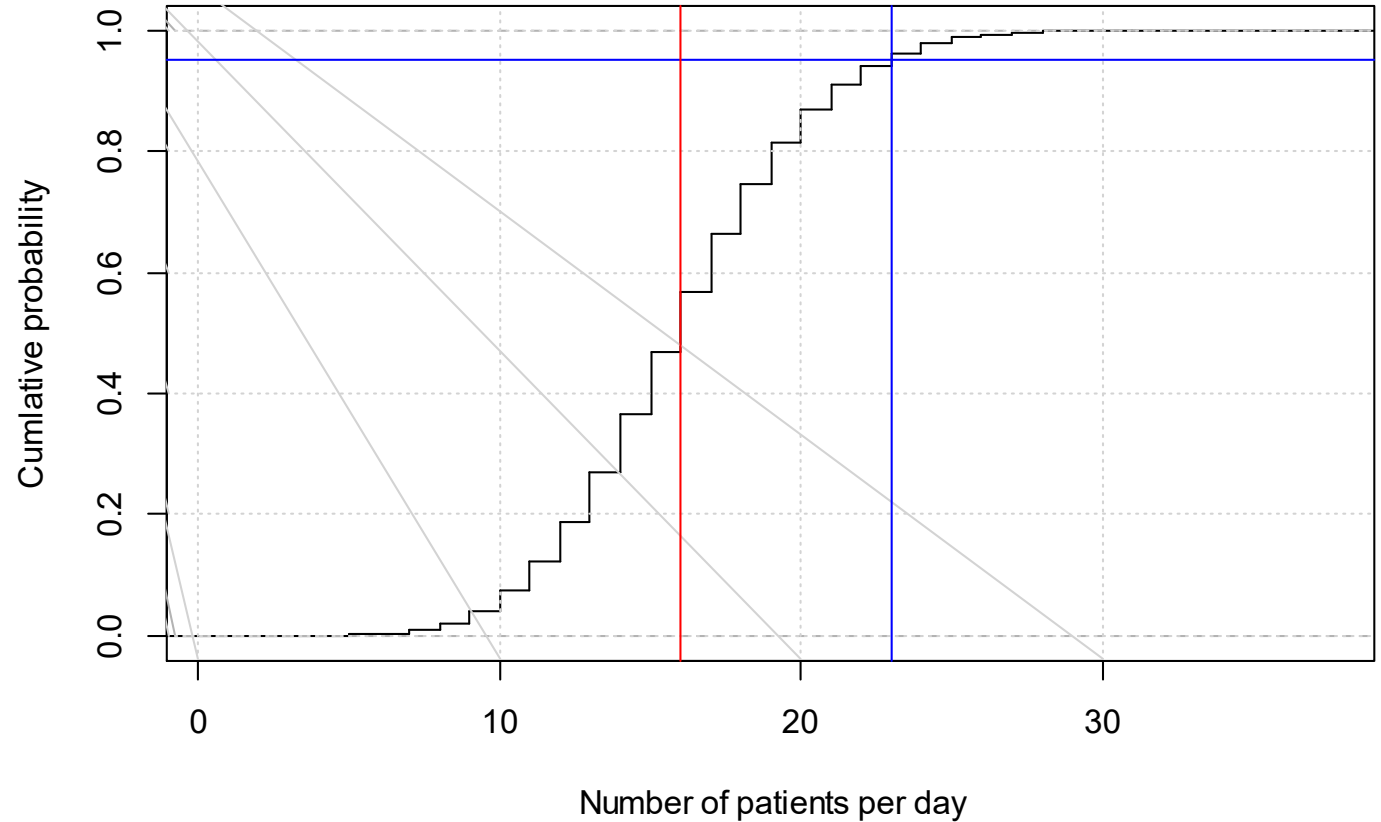
NUMBER OF BEDS
ON A DAY WARD

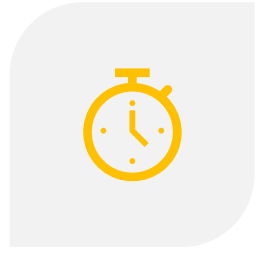




How to avoid the flaw of averages

- Boss: I need a number?
- Analyst: I can give you a distribution.
- Boss: I just need a number – can you use an average?
- Analyst: No but if you tell me the number you want and I will tell you the chances





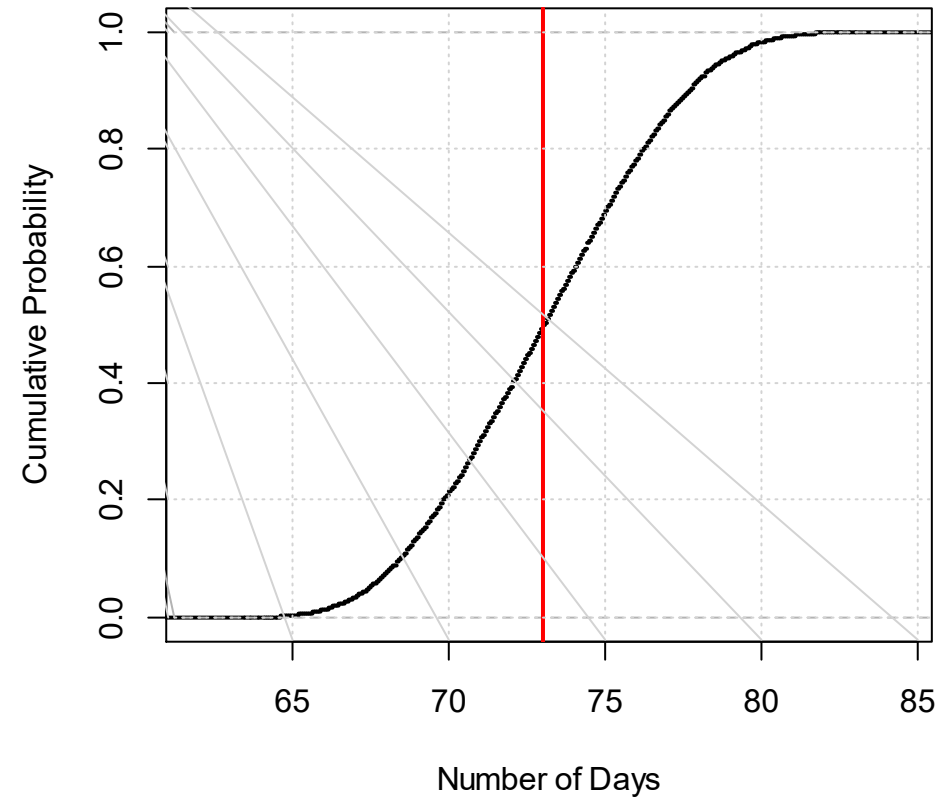
DURATION OF A
PROJECT

Project duration
(days)
Sequential Tasks

Task	Min to Max	Average
A	10 to 20	[15]
B	13 to 15	[14]
C	8 to 12	[10]
D	4 to 6	[5]
E	21 to 25	[23]
F	5 to 7	[6]
Total	Min[61] Max [85]	Avg [73]



Simulated Days



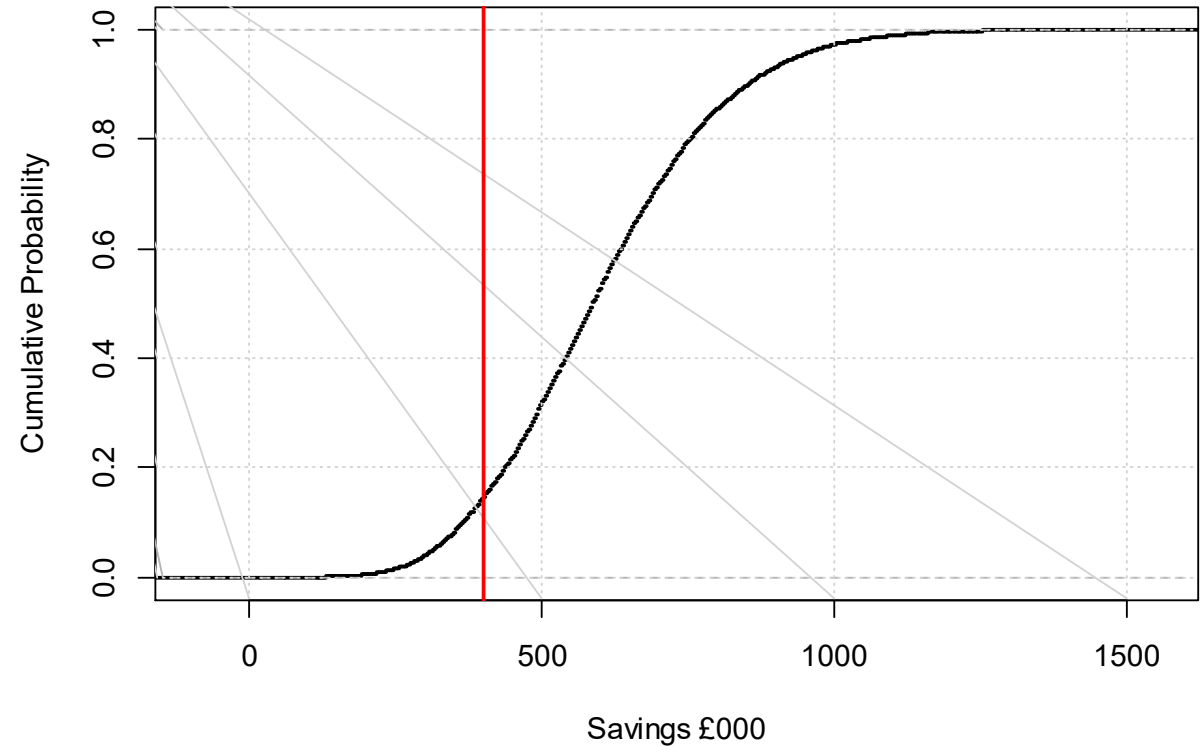
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CT scanner

- A hospital is considering leasing a new CT scanner at £400,000 per year to replace the existing old CT scanner.
- It is estimated (on average) that annual
 - Maintenance savings (MS) = £15 per scan [5 to 20]
 - Labour savings (LS) = £3 per scan [-3 to 8]
 - Raw materials savings (RMS) = £6 per scan [1 to 9]
 - Production level (PL) = 25000 scans per year [15K to 35K]
- Annual Savings = $(MS + LS + RMS) \times PL = £600,000$

CT scanner

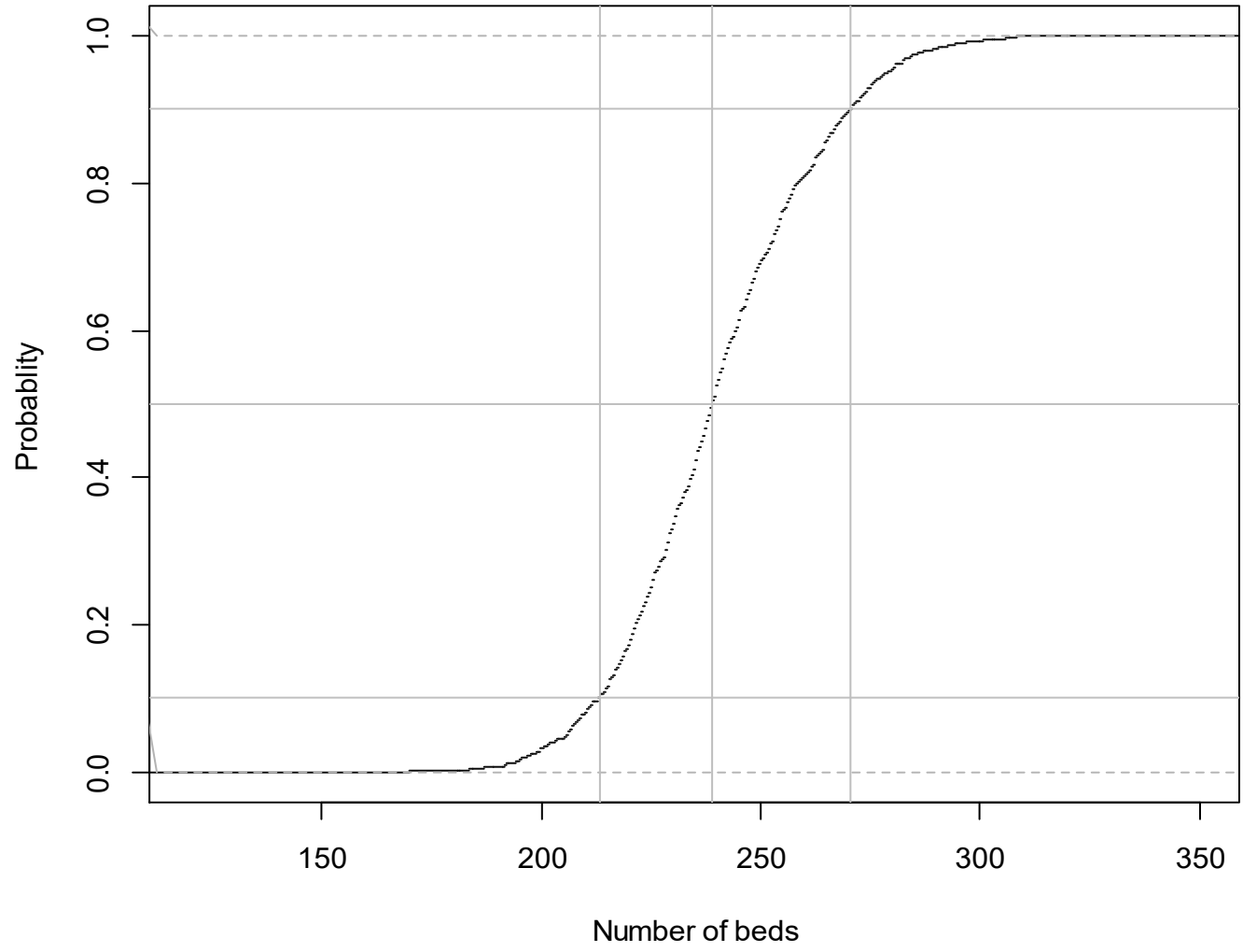
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~15% chance of not breaking even 400K

Maternity unit toy example

- Average number of births per day is 120 (Poisson: 87 to 153)
- Average LoS is 2 days (Triangular 1,2,3)
- Average number of beds is $120 * 2 = 240$

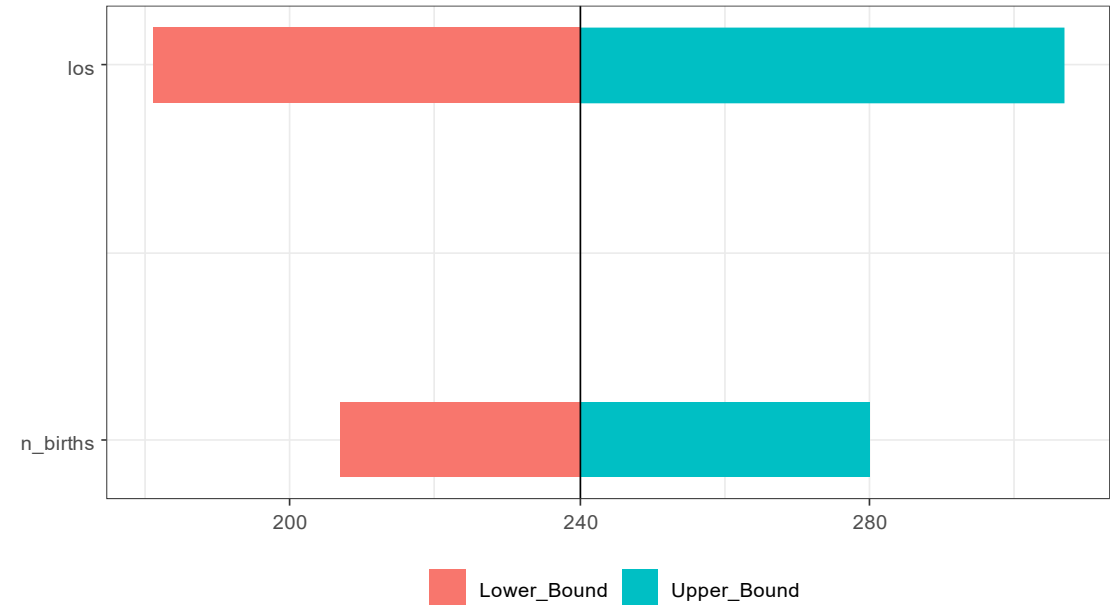
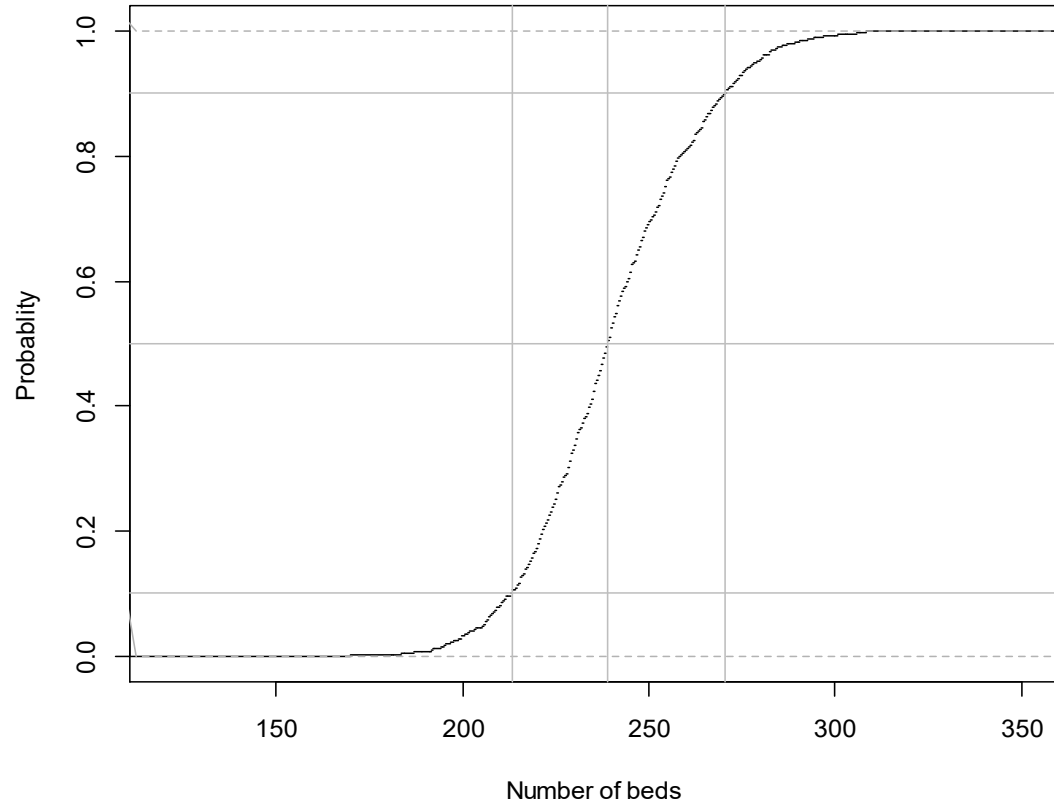


Maternity unit toy example

- Average number of births per day is 120 (Poisson: 87 to 153)
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The uncertainty of which variable has the largest impact on number of beds

Average number of births per day is 120 (Poisson: 87 to 153)
Average LoS is 2 days (Triangular 1 to 3)
Average number of beds is $120 * 2 = 240$





MOBILE PHONE
INSURANCE

To insure or not insure?

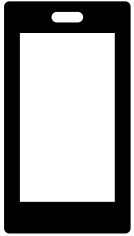
Insurance against accidental breakage costs £100

New mobile phone costs £850

Initial Decision

Possibilities

Cost



To insure or Not to Insure?

Sensitivity analysis

Heatmap ▾

Minimum ▾



payoff ▾

policy ▾

policy number ▾

payoff ▾

p_break ▾

	p_break	0	0.02	0.04	0.06	0.08	0.1	0.12	0.14	0.16	0.18	0.2	Totals
policy													
Insure:No Don't insure		0.00	17.00	34.00	51.00	68.00	85.00	102.00	119.00	136.00	153.00	170.00	0.00
Insure:Yes Insure		100.00	101.00	102.00	103.00	104.00	105.00	106.00	107.00	108.00	109.00	110.00	100.00
Totals		0.00	17.00	34.00	51.00	68.00	85.00	102.00	107.00	108.00	109.00	110.00	0.00

Addressing uncertainty leads to more certainty

- Don't ignore uncertainty
- Probability is the language of uncertainty
- Use probability (distributions) to accommodate uncertainty
- Avoid the flaw of averages (point estimates)
- Estimate low, middle, high values
- Probability distributions will provide more (not less) insight
 - S-curve
 - Tornado plot
- Reflections...



Share your insights...



Any key insights...



So what...
(any scope for application)

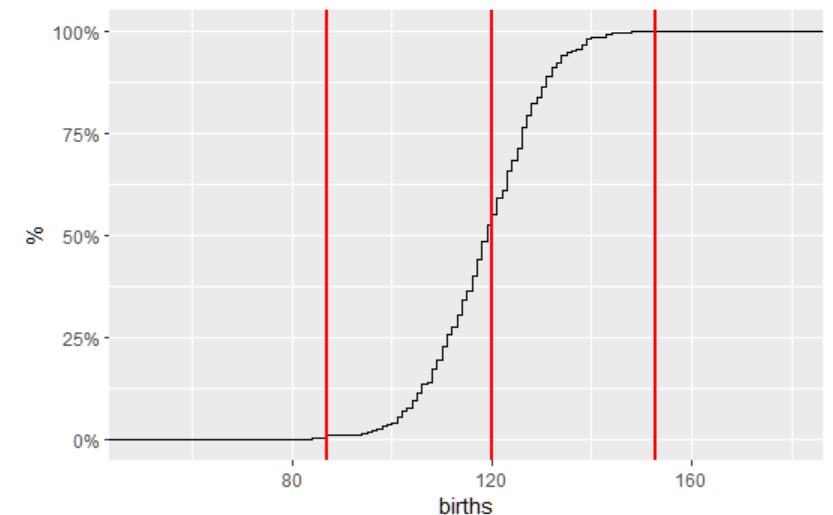
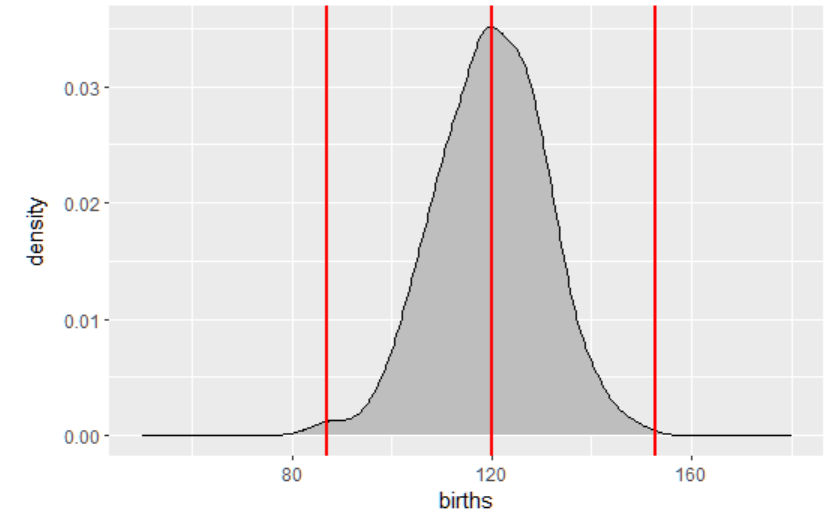


One wish...

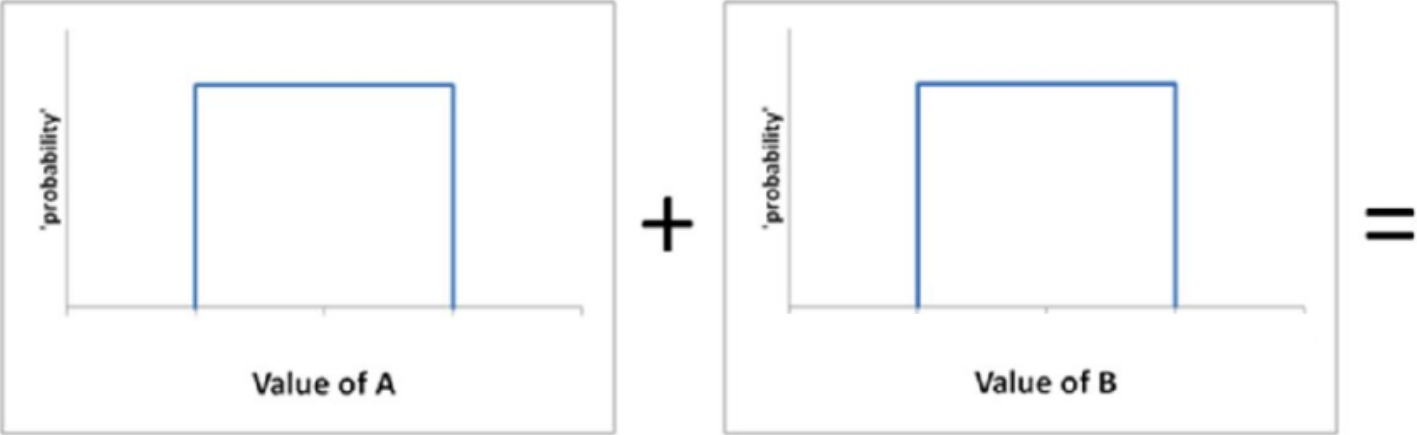
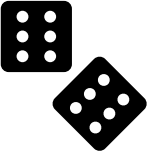
Reflections 1-2-4(All)

Summarising probability distributions

- Where is the middle
 - Mean, Median, Mode
- What is the spread
 - Range, Standard deviation
- Where is the 90% confidence interval
- What's are the chances for a given value
- The s-curve
 - P10/P50/P90



The Math of Uncertainty



Source: David Vose: The Perplexing Math of Uncertainty

The Perplexing Math of Uncertainty

