

Ben Franklin: America's First Operations Researcher

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Presented in tribute to Saul Gass on his 80th Birthday
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Outline of Talk

- A quick look at the Ben Franklin you already know about
- A peek at some of Ben Franklin's work in operations research
- So, what does this have to do with Saul Gass, anyway?

Ben Franklin and the Invention of America

- Born in Boston on January 17, 1706
- Best scientist, inventor, diplomat, writer, and businessman (printer and publisher) in America in the 1700s
- Great political and practical thinker
- Proved that lightning was electricity
- Inventions include bifocal glasses, the clean-burning stove, and the lightning rod
- Founded a library, college, fire department, and many other civic associations

More about Ben Franklin

- Only person to sign all of the following
 - The Declaration of Independence
 - The Constitution of the United States
 - The Treaty of Alliance with France
 - The Treaty of Peace with Great Britain
- Retired from business at age 42, lived 84 years
- He also made significant contributions to recreational mathematics
 - Magic squares
 - Magic circles

Franklin Magic Squares

52	61	4	13	20	29	36	45
14	3	62	51	46	35	30	19
53	60	5	12	21	28	37	44
11	6	59	54	43	38	27	22
55	58	7	10	23	26	39	42
9	8	57	56	41	40	25	24
50	63	2	15	18	31	34	47
16	1	64	49	48	33	32	17

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Each row sum = each column sum = 260

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52	61	4	13	20	29	36	45
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Any half-row or half-column totals 130

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52	61	4	13	20	29	36	45
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Any 2x2 block (including wrap-around) sums to 130

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53	60	5	12	21	28	37	44
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Any set of four cells forming a rectangle with an even number of cells on each side sums to 130

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The shaded entries sum to 260

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Each of the two bent rows above totals 260

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Each of the two bent columns above totals 260

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Each of the 5 parallel bent columns above totals 260

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Each of the three “wrap-around” bent columns totals 260

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Franklin Magic Squares: Final Remarks

- There are nine additional pages of properties
- Franklin's most impressive square is 16 by 16
- It has many additional properties
- See the June-July 2001 issue of The American Mathematical Monthly for details
- Mathematicians today are trying to determine how Franklin constructed these squares
- This is a constraint satisfaction problem which can be modeled as an IP

Ben Franklin's Decision-Making Tool (1730)

Pros	Cons
Factor A	Factor D
Factor B	Factor E
Factor C	Factor F
	Factor G

- Each factor has a weight
- His technique was a precursor to cost-benefit analysis and the AHP

Data-Driven Modeling

- Ben Franklin wrote “Observations Concerning the Increase of Mankind” in 1751, based on his empirical calculations
- He observed
 - Colonists were more likely to marry than the English
 - They married younger
 - They averaged twice as many children
- His calculations led him to conclude that America’s population would exceed that of England in 100 years
- He was exactly right
- His work was cited by Adam Smith and Thomas Malthus

Conclusions

- Ben Franklin was one of the few operations researchers to pre-date Saul Gass
- His interests in constraint satisfaction, decision-making, and modeling coincide nicely with Saul's research interests
- Both were leaders in their fields
- We congratulate Ben and Saul on their (major) birthdays

One Last Connection



Painting by Benjamin West (adapted)