

New Approaches to Adaptive Water Management under Uncertainty

GANetXL

Evolutionary Optimisation for Microsoft Excel

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Outline

- General description
- Structure & features of the application
- Definition of the optimisation problem
- Live demonstration
- Software & hardware requirements
- Getting GANetXL







Description

A user friendly add-in which integrates into Microsoft Excel



- Uses evolutionary algorithms to solve complex optimisation problems
- Interacts with Excel using COM interface







Structure of GANetXL







List of Features



- Single and multiple-objective optimisation techniques
- Support for integration with simulation packages
- Suspend, resume
- Multiple-objective results browser
- Batch runs
- User defined constraints & penalty multipliers
- Automatic saving of population
- Backups of intermediate population
- Visualisation of results and progress
- Built-in help
- User manual





Defining the Problem

- Decision variables Genes altered by GA within their ranges (x₁,x₂,x₃,x₄) must occupy continuous range
- Objective function(s) used to evaluate the fitness of solutions (formula in C6)
- Constraints

 used to limit values of
 objective function(s)
 (formula in C8)

	Α	В	С	D	E	
1						
2		x1	x2	x3	x4	
3		1	· 3	4	5	
4						

	C6	•	‰ =B3+C3+D3+E3				
	А	В	С	D	E		
1							
2		x1	x2	x3	x4		
3		1	3	4	5		
5							
6		y=	13				











- 1. Single-objective
 - optimisation of an advertising campaign
 - optimisation of a simple mathematical problem (learning by doing)
- 2. Multiple-objective
 - optimisation of an advertising campaign
- 3. Link with simulation software
 - Generating policy options for optimum management of groundwater contamination risks







optimisation of an advertising campaign (single objective)

Advertising Selection

Select the most effective advertising plan to reach the largest audience while meeting your budget of \$50,000. TV and magazines allows discount rates if you advertise with them often.

				Potential	
Media	 Quan.	Cost	Sub-Total	Audience	total aud
TV (15 sec. ad)	0	\$2,000	\$0	3,000	0
Magazine (monthly)	0	\$3,000	\$0	5,000	0
Newspaper (half page)	13	\$1,000	\$13,000	3,500	45,500
Radio (30 sec. ad)	16	\$300	\$4,800	500	8,000
Direct Mail (5K pieces)	5	\$6,000	\$31,500	16,000	80,000
		total spent	\$49,300		133,500

Optimize:

Penalty

133,500 0

Per Ad Cost	quantity	ΤV	Magazine
	0	2000	3000
-	4	1800	2700
-	8	1650	2300
-	12	1600	2250







Maximise $f(x) = x^2$ $0 \le x \le 31$ *i.e.*, x = 0,1,...,30,31







Main steps of setting up a problem in GANetXL

- 1)To create an empty workbook it is recommended to use the Empty Project template which is located in GANetXL's folder in Start menu.
- 2) This template creates an initial workbook:
- Configuration wizard is used to configure all required parameters of the application. It allows setting up various options of genetic algorithm, defining cells containing values of design variables, objective functions, etc.
- 4) Decide in which cell you want to put x and in which cell f(x).
- 5) Start configuration wizard:
- 6) Under genetic algorithm set the following:
 - type : single objective
 - population: 5
 - Algorithm: Generational
 - Crossover: simple one point and crossover rate 0.95
 - Selector: Tournament
 - Mutator: Simple by gene and mutation rate 0.05







Problem setting continued

- 7) Under Excel Link
- 8) Enter the location of variable in the box and set its type and range in the table
- 9) Do the same for objective function
- 10) Problem setting can be viewed by unhiding the setting worksheet
- 11) Run button starts the optimisation; To run the algorithm, cursor has to be on the problem worksheet.
- 12) Results can be accessed from the results worksheet which was selected prior to starting the GA.





optimisation of an advertising campaign (Multi-objective)



Advertising Selection		Select the most effective advertising plan to reach the largest audie while meeting your budget of \$50,000. TV and magazines allows discount rates if you advertise with them often.					
Media		Quan.	Cost	Sub-Total	Potential Audience	total aud	
TV (15 sec. ad)		0	\$2,000	\$0	3,000	0	
Magazine (monthly)		0	\$3,000	\$0	5,000	0	
Newspaper (half page)		14	\$1,000	\$14,000	3,500	49,000	
Radio (30 sec. ad)		0	\$300	\$0	500	0	
Direct Mail (5K pieces)		4	\$6,000	\$25,500	16,000	64,000	
			total spent				
				\$39,500	113,000		
			Infeasibility	0.00		-	
Per Ad Cost	quantity	ΤV	Magazine				
	0	2000	3000				
	4	1800	2700				
	8	1650	2300				
	12	1600	2250				



Optimum management of groundwater contamination (case study from Denmark)





Supported Platforms



- Microsoft Windows
 - Vista (not tested but should work)
 - XP
 - **2000**
- Microsoft Excel
 - **2007**
 - **2003**
 - XP
 - **2000**









Licenses are bound to specific computer



- Serial number
 - contains expiration date
 - valid for limited number of days
 - chromosome size, population size
 - objectives count, generations count









To get a copy of GANetXL please contact:

Prof. Dragan Savic (d.savic@ex.ac.uk)

Intranet website dedicated to GANetXL: http://cws/ganetxl/

Support, reporting bugs and problems: Josef Bicik (j.bicik@ex.ac.uk)

