

# Contoh Soal Program Non-Linier dengan Menggunakan Excel Solver

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**Contoh Konsep Program Non-Linier (hal.1-18)**

$$\begin{aligned} \text{Min } Z &= a^2 + b^2 + c^2 + 20(a-50) + 20(a+b-100) \\ &= \mathbf{7.500,00} \end{aligned}$$

Variables:    a            b            c            Z  
 Jawaban:    **50,00**    **50,00**    **50,00**    **7.500,00**

Fungsi Tujuan:	Koefisien			LHS		RHS	Slack
	1,00	1,00	1,00				
Kendala:	Koefisien			LHS		RHS	Slack
	1,00	0,00	0,00	50,00	>=	50,00	0,00
	1,00	1,00	0,00	100,00	>=	100,00	0,00
	1,00	1,00	1,00	150,00	>=	150,00	0,00

**Ref:** Djoko Luknanto, *Pengantar Optimasi Non-Linier*, Jurusan Teknik Sipil, FT UGM, 1996.

**Microsoft Excel 9.0 Sensitivity Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP01**  
**Report Created: 23/06/00 6:45:35**

Adjustable Cells

Cell	Name	Final Value	Reduced Gradient
\$B\$6	Jawaban: a	50,00	0,00
\$C\$6	Jawaban: b	50,00	0,00
\$D\$6	Jawaban: c	50,00	0,00

Constraints

Cell	Name	Final Value	Lagrange Multiplier
\$E\$12	LHS	100,00	20,00
\$E\$11	LHS	50,00	20,00
\$E\$13	LHS	150,00	100,00

**Microsoft Excel 9.0 Limits Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP01**  
**Report Created: 23/06/00 6:45:35**

<b>Cell</b>	<b>Target Name</b>	<b>Value</b>
\$E\$6	Jawaban: Z	7.500,00

<b>Cell</b>	<b>Adjustable Name</b>	<b>Value</b>	<b>Lower Limit</b>	<b>Target Result</b>	<b>Upper Limit</b>	<b>Target Result</b>
\$B\$6	Jawaban: a	50,00	50,00	7500,00	#N/A	#N/A
\$C\$6	Jawaban: b	50,00	50,00	7500,00	#N/A	#N/A
\$D\$6	Jawaban: c	50,00	50,00	7500,00	#N/A	#N/A

**Contoh Soal 1 Non-Linier (hal. lepas)**

$$\begin{aligned} \text{Min } Z &= X_1^2 + X_2^2 \\ &= \mathbf{37,90} \end{aligned}$$

Variables:  $X_1$        $X_2$        $Z$   
 Jawaban:    **2,20**      **5,75**      **37,90**

Fungsi Tujuan:	Koefisien					
	1,00	1,00				
Kendala:	Koefisien		LHS		RHS	Slack
		1,00	1,00	25,00	<=	25,00
	1,00	1,00	16,00	>=	16,00	0,00

**Ref:** Djoko Luknanto, *Pengantar Optimasi Non-Linier*, Jurusan Teknik Sipil, FT UGM, 1996.

**Microsoft Excel 9.0 Sensitivity Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP02**  
**Report Created: 23/06/00 6:53:55**

Adjustable Cells

Cell	Name	Final Value	Reduced Gradient
\$B\$6	Jawaban: X1	2,20	0,00
\$C\$6	Jawaban: X2	5,75	0,00

Constraints

Cell	Name	Final Value	Lagrange Multiplier
\$D\$11	LHS	25,00	-2,51
\$D\$12	LHS	16,00	1,93

**Microsoft Excel 9.0 Limits Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP02**  
**Report Created: 23/06/00 6:53:55**

<b>Cell</b>	<b>Target Name</b>	<b>Value</b>
\$D\$6	Jawaban: Z	37,90

<b>Cell</b>	<b>Adjustable Name</b>	<b>Value</b>	<b>Lower Limit</b>	<b>Target Result</b>	<b>Upper Limit</b>	<b>Target Result</b>
\$B\$6	Jawaban: X1	2,20	2,20	37,90	2,20	37,90
\$C\$6	Jawaban: X2	5,75	5,75	37,90	5,75	37,90

**Contoh Soal 2 Non-Linier (hal. lepas)**

$$\begin{aligned}\text{Min } Z &= X_1 - X_2 + 2X_1^2 + 2X_1X_2 + X_2^2 \\ &= \mathbf{-1,25}\end{aligned}$$

Variables:	$X_1$	$X_2$	$Z$
Jawaban:	<b>-1,00</b>	<b>1,50</b>	<b>-1,25</b>

**Ref:** Djoko Luknanto, *Pengantar Optimasi Non-Linier*, Jurusan Teknik Sipil, FT UGM, 1996.



**Microsoft Excel 9.0 Sensitivity Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP03**  
**Report Created: 23/06/00 7:00:19**

Adjustable Cells

<b>Cell</b>	<b>Name</b>	<b>Final Value</b>	<b>Reduced Gradient</b>
\$B\$6	Jawaban: X1	-1,00	0,00
\$C\$6	Jawaban: X2	1,50	0,00

Constraints  
NONE

**Microsoft Excel 9.0 Limits Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP03**  
**Report Created: 23/06/00 7:00:19**

<b>Cell</b>	<b>Target Name</b>	<b>Value</b>
\$D\$6	Jawaban: Z	-1,25

<b>Cell</b>	<b>Adjustable Name</b>	<b>Value</b>	<b>Lower Limit</b>	<b>Target Result</b>	<b>Upper Limit</b>	<b>Target Result</b>
\$B\$6	Jawaban: X1	-1,00	#N/A	#N/A	#N/A	#N/A
\$C\$6	Jawaban: X2	1,50	#N/A	#N/A	#N/A	#N/A

**Contoh Soal 3 Non-Linier (hal.lepas)**

$$\text{Min } Z = (X_1 - 2)^2 + (X_2 - 2)^2$$

$$= \mathbf{0,80}$$

Variables:  $X_1$        $X_2$        $Z$   
 Jawaban:    **1,60**      **1,20**      **0,80**

<b>Fungsi Tujuan:</b>	Koefisien					
	1,00	1,00				
<b>Kendala:</b>	Koefisien		LHS		RHS	Slack
	1,00	2,00	4,00	<=	4,00	0,00

**Ref:** Djoko Luknanto, *Pengantar Optimasi Non-Linier*, Jurusan Teknik Sipil, FT UGM, 1996.

**Microsoft Excel 9.0 Sensitivity Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP04**  
**Report Created: 23/06/00 7:05:55**

Adjustable Cells

<b>Cell</b>	<b>Name</b>	<b>Final Value</b>	<b>Reduced Gradient</b>
\$B\$6	Jawaban: X1	1,60	0,00
\$C\$6	Jawaban: X2	1,20	0,00

Constraints

<b>Cell</b>	<b>Name</b>	<b>Final Value</b>	<b>Lagrange Multiplier</b>
\$D\$11	LHS	4,00	-0,80

**Microsoft Excel 9.0 Limits Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP04**  
**Report Created: 23/06/00 7:05:56**

<b>Cell</b>	<b>Target Name</b>	<b>Value</b>
\$D\$6	Jawaban: Z	0,80

<b>Cell</b>	<b>Adjustable Name</b>	<b>Value</b>	<b>Lower Limit</b>	<b>Target Result</b>	<b>Upper Limit</b>	<b>Target Result</b>
\$B\$6	Jawaban: X1	1,60	0,00	4,64	1,60	0,80
\$C\$6	Jawaban: X2	1,20	0,00	4,16	1,20	0,80

**Contoh Soal 4 Non-Linier (hal. lepas)**

$$\begin{aligned} \text{Max } Z &= X_1 X_2 X_3 \\ &= \mathbf{3.456,00} \end{aligned}$$

Variables:  $X_1$        $X_2$        $X_3$        $Z$   
 Jawaban:    **24,00**      **12,00**      **12,00**      **3.456,00**

Fungsi Tujuan:	Koefisien						
	1,00	1,00	1,00				
Kendala:	Koefisien			LHS		RHS	Slack
		1,00	2,00	2,00	72,00	<=	72,00
	1,00	0,00	0,00	24,00	<=	42,00	18,00

**Ref:** Djoko Luknanto, *Pengantar Optimasi Non-Linier*, Jurusan Teknik Sipil, FT UGM, 1996.

**Microsoft Excel 9.0 Sensitivity Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP05**  
**Report Created: 23/06/00 7:17:42**

Adjustable Cells

Cell	Name	Final Value	Reduced Gradient
\$B\$6	Jawaban: X1	24,00	0,00
\$C\$6	Jawaban: X2	12,00	0,00
\$D\$6	Jawaban: X3	12,00	0,00

Constraints

Cell	Name	Final Value	Lagrange Multiplier
\$E\$11	LHS	72,00	144,00
\$E\$12	LHS	24,00	0,00

**Microsoft Excel 9.0 Limits Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP05**  
**Report Created: 23/06/00 7:17:42**

<b>Cell</b>	<b>Target Name</b>	<b>Value</b>
\$E\$6	Jawaban: Z	3.456,00

<b>Cell</b>	<b>Adjustable Name</b>	<b>Value</b>	<b>Lower Limit</b>	<b>Target Result</b>	<b>Upper Limit</b>	<b>Target Result</b>
\$B\$6	Jawaban: X1	24,00	0,00	0,00	24,00	3456,00
\$C\$6	Jawaban: X2	12,00	0,00	0,00	12,00	3456,00
\$D\$6	Jawaban: X3	12,00	0,00	0,00	12,00	3456,00



**Contoh Soal 5 Non-Linier (hal. lepas)**

$$\begin{aligned} \text{Max } Z &= -X_1^2 - X_2^2 + X_1X_2 + 8X_1 + 4X_2 \\ &= \mathbf{240,00} \end{aligned}$$

Variables:  $X_1$        $X_2$        $Z$

Jawaban: **12,00**      **0,00**      **240,00**

Fungsi Tujuan:	Koefisien					
	8,00	4,00				
Kendala:	Koefisien		LHS		RHS	Slack
	2,00	3,00	0,00	<=	24,00	24,00
	-5,00	12,00	-60,00	<=	24,00	84,00
	0,00	1,00	0,00	<=	5,00	5,00

**Ref:** Djoko Luknanto, *Pengantar Optimasi Non-Linier*, Jurusan Teknik Sipil, FT UGM, 1996.

**Microsoft Excel 9.0 Sensitivity Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP06**  
**Report Created: 14/07/00 13:05:31**

Adjustable Cells

Cell	Name	Final Value	Reduced Gradient
\$B\$6	Jawaban: X1	12,00	0,00
\$C\$6	Jawaban: X2	0,00	-32,00

Constraints

Cell	Name	Final Value	Lagrange Multiplier
\$D\$11	LHS	24,00	16,00
\$D\$12	LHS	-60,00	0,00
\$D\$13	LHS	0,00	0,00

**Microsoft Excel 9.0 Limits Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP06**  
**Report Created: 14/07/00 13:05:32**

<b>Cell</b>	<b>Target Name</b>	<b>Value</b>
\$D\$6	Jawaban: Z	240,00

<b>Cell</b>	<b>Adjustable Name</b>	<b>Value</b>	<b>Lower Limit</b>	<b>Target Result</b>	<b>Upper Limit</b>	<b>Target Result</b>
\$B\$6	Jawaban: X1	12,00	0,00	0,00	12,00	240,00
\$C\$6	Jawaban: X2	0,00	0,00	240,00	0,00	240,00

**Contoh Soal 1 Non-Linier (hal. lepas)**

$$\begin{aligned} \text{Max } Z &= X_1^2 + X_2^2 \\ &= \mathbf{250,17} \end{aligned}$$

Variables:  $X_1$        $X_2$        $Z$   
 Jawaban:     $\mathbf{8,77}$        $\mathbf{13,16}$        $\mathbf{250,17}$

Fungsi Tujuan:	Koefisien					
	1,00	1,00				
Kendala:	Koefisien		LHS		RHS	Slack
	1,00	1,00	25,00	<=	25,00	0,00
	1,00	1,00	45,64	>=	16,00	29,64

**Ref:** Djoko Luknanto, *Pengantar Optimasi Non-Linier*, Jurusan Teknik Sipil, FT UGM, 1996.

**Microsoft Excel 9.0 Sensitivity Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP07**  
**Report Created: 14/07/00 11:15:12**

Adjustable Cells

Cell	Name	Final Value	Reduced Gradient
\$B\$6	Jawaban: X1	8,77	0,00
\$C\$6	Jawaban: X2	13,16	0,00

Constraints

Cell	Name	Final Value	Lagrange Multiplier
\$D\$11	LHS	25,00	3,16
\$D\$12	LHS	45,64	0,00

**Microsoft Excel 9.0 Limits Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP07**  
**Report Created: 14/07/00 11:15:12**

<b>Cell</b>	<b>Target Name</b>	<b>Value</b>
\$D\$6	Jawaban: Z	250,17

<b>Cell</b>	<b>Adjustable Name</b>	<b>Value</b>	<b>Lower Limit</b>	<b>Target Result</b>	<b>Upper Limit</b>	<b>Target Result</b>
\$B\$6	Jawaban: X1	8,77	3,23	183,61	8,77	250,17
\$C\$6	Jawaban: X2	13,16	9,88	174,63	13,16	250,17

**Contoh Soal 1-1 Environmental Systems Analysis (hal. 7)****Fungsi tujuan: Max Z = 4\*X - Y****= 14,028**

Variables: X Y Z

Jawaban: **4,548 4,163 14,028**

<b>Kendala:</b>	LHS		RHS	Slack
$3X - Y \geq 0,00$	9,48	$\geq$	0,00	9,48
$X \leq 5,50$	4,55	$\leq$	5,50	0,95
$Y \leq 14,00$	4,16	$\leq$	14,00	9,84
$3X - Y + 0,03Y^2 \leq 10,00$	10,00	$\leq$	10,00	0,00

**Keterangan:** X adalah jumlah produksi logam tiap minggu ( $10^4$  kg/minggu)Y adalah jumlah limbah yang diproses tiap minggu ( $10^4$  kg/minggu)**Ref:** Haith, Douglas A., "Environmental Systems Optimization," John Wiley & Sons, Inc., USA, 1982.

**Microsoft Excel 9.0 Sensitivity Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP08**  
**Report Created: 18/02/01 9:53:41**

## Adjustable Cells

Cell	Name	Final Value	Reduced Gradient
\$B\$6	X	4,548	0,000
\$C\$6	Y	4,163	0,000

## Constraints

Cell	Name	Final Value	Lagrange Multiplier
\$D\$9	$\geq 0,00$ LHS	9,48	0,00
\$D\$10	$\leq 5,50$ LHS	4,55	0,00
\$D\$11	$\leq 14,00$ LHS	4,16	0,00
\$D\$12	$\leq 10,00$ LHS	10,00	1,33



**Microsoft Excel 9.0 Limits Report**  
**Worksheet: [Contoh Soal NLP-Solver.xls]NLP08**  
**Report Created: 18/02/01 9:53:42**

Target		
Cell	Name	Value
\$D\$6	Jawaban: Z	14,028

Adjustable			Lower Target		Upper Target	
Cell	Name	Value	Limit	Result	Limit	Result
\$B\$6	X	4,548	1,388	1,388	4,548	14,028
\$C\$6	Y	4,163	4,163	14,028	13,643	4,548