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11/25 11/10

trade-off

11/63 11/40

.11/63 11/40 11/10

**Determination Of Efficient Production's Plans For Risk  
For Electrical Transformers Factory Buy Using The  
Minimization Of Total Absolute Deviations Model**

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**ABSTRACT**

The aim of the research is to determine the efficient production's plans for risk to electrical transformers factory by using the minimization of total absolute deviations model (MOTAD) as a linear alternative model for quadratic programming under risk and uncertainty.

The study confirmed that the plans of production which take in consideration risk are differ from plans which don't take in consideration risk. And there had been a sort of (trade- off) between expected income and risk associated with it. So if the management of factory prefers risk, it must produce the transformers 10/11, 25/11, 40/11 and 63/11, or a risk aversion, it must produce the transformers 10/11, 40/11 and 63/11.

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Risk And )

(Uncertainty

(Decision Taking)

(Decision Making)

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Minimization Of Total ) (MOTAD)

(Absolute Deviations  
(Quadratic Programming)

.(Parametric Linear Programming)

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(Outputs)

(Data)

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$X_{10}$	33/100
	<b>k.v.a.</b>
$X_1$	11/10
$X_2$	11/25
$X_3$	11/40
$X_4$	11/63
$X_5$	11/100
$X_6$	33/10
$X_7$	33/25
$X_8$	33/40
$X_9$	33/63

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(E - A)

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1971 (8) ( ) (Quadratic Programming)  
Parametric Linear )  
(Model

(Variance, V.)

A

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:(7)

.1 (Risk Neutral)

.2 (Risk Prefer)

.3 (Risk Aversion)

: (8)

$$\text{Minimize } \sum_{h=1}^n Yh^{-1} \quad (1)$$

Subject To :

$$\sum_{j=1}^n (Chi - gi)Xj + yh^{-} \geq 0 \quad (2)$$

( h=1, 2, ...,s ) h

$$\sum_{j=1}^n FjXj = \lambda \quad 0 < \lambda < E \quad \text{MAX} \quad (3)$$

$$\sum_{j=1}^n \partial_{ij} Xj \leq b_i \quad (4)$$

( i=1, 2, ...,m ) i

$$X_j, Yh^{-} \geq 0 \quad (5)$$

j, h

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$$Yh^{-} = (h)$$

$$S =$$

$$C_{hj} = (h)$$

$$g_j = j$$

$$X_j = (j = 1, 2, \dots, n) j$$

$$F_j = (\text{Gross Margin}) (j)$$

$$b_i = (i= 1, 2, \dots, m) i$$

$$a_{ij} = (i) (j)$$

$\lambda =$

h

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(1):

	$X_1$	$X_2$	-	-	$X_n$	$d_1$	$d_2$	---	-	$d_n$	
Min.	0	0	-	-	0	1	1	-	-	1	
(1)	$a_{11}$	$a_{12}$	-	-	$a_{1n}$	0	0	-	-	0	$\leq b_1$
(2)	$a_{21}$	$a_{22}$	-	-	$a_{2n}$	0	0	-	-	0	$\leq b_2$
:	-		:	:	:	:	:	0	:	0	0
:	-		:	:	:	0	0	0	0	0	0
(M)	$a_{m1}$	$a_{m2}$	-	-	$a_{mn}$	-	-	-	-	0	$\leq b_n$
	1	0	0	0	0	0	0	0	0	0	$\geq 0$
	0	1	0	0	0	0	0	0	0	0	$\geq 0$
:	:	:	:	:	:	:	:	:	:	:	$\geq 0$
M	0	0	0	0	0	0	0	0	0	1	$\geq 0$
	$d_{11}$	$d_{12}$	-	-	-	$d_{1n}$	-	-	-	-	$\geq 0$
	$d_{21}$	$d_{22}$	-	-	-	-	$d_{2n}$	-	-	-	$\geq 0$
:	:	:	:	:	:	:	:	:	:	:	$\geq 0$
(h)	$d_{m1}$	$d_{m2}$	-	-	-	-	-	-		$d_{mn}$	$\geq 0$
(h)	$F_1$	$F_2$	$F_3$	-	$F_n$	0	0	0	-	0	$= \lambda$



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(λ)

A

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S.D

$$S.D = A \left[ \frac{\pi S}{2(S-1)} \right]^{\frac{1}{2}} \quad (6)$$

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S.D. =

A =

$$\pi = \frac{22}{7}$$

S = ( )

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2008

Risk- free )

.(5)(plan

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(6)

$C_j$

(Objective Function)

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Non Negativity )

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$X_j \geq 0$

(Restrictions)

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:(2)

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Variable	X <sub>1</sub>	X <sub>2</sub>	....	X <sub>10</sub>	Direction	R.H.S.
Maximize	142000	208000	....	475000		
C <sub>1</sub>	189	347	....	1091	≤	2143434
C <sub>2</sub>	83	145	....	810	≤	904495
C <sub>3</sub>	101	125	....	314	≤	771989
C <sub>4</sub>	17	98	....	133	≤	462242
C <sub>5</sub>	42	4	....	230	≤	374027
C <sub>6</sub>	41	106	....	400	≤	601767
C <sub>7</sub>	189	255	....	1016	≤	1358431
C <sub>8</sub>	1	0	....	0	≥	0
C <sub>9</sub>	0	1	....	0	≥	0
C <sub>10</sub>	0	0	....	0	≥	0
C <sub>11</sub>	0	0	....	0	≥	0
C <sub>12</sub>	0	0	....	0	≥	0
C <sub>13</sub>	0	0	....	0	≥	0
C <sub>14</sub>	0	0	....	0	≥	0
C <sub>15</sub>	0	0	....	0	≥	0
C <sub>16</sub>	0	0	....	0	≥	0
C <sub>17</sub>	0	0	....	1	≥	0

(Quantitative System Of Business)

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Decision Variable	Solution Value	Reduced Cost	Basis Status	Allowable Min. (Cj)	Allowable Max. (Cj)
X <sub>1</sub>	248	....	basic	120000	147000
X <sub>2</sub>	3,220	....	basic	205000	246000
X <sub>3</sub>	845	....	basic	242000	349000
X <sub>4</sub>	561	....	basic	347000	365000
X <sub>5</sub>	0	-14000	at bound	- M	503000
X <sub>6</sub>	0	- 63000	at bound	- M	234000
X <sub>7</sub>	0	-114000	at bound	- M	367000
X <sub>8</sub>	0	-131000	at bound	- M	451000
X <sub>9</sub>	0	-137000	at bound	- M	544000
X <sub>10</sub>	0	-264000	at bound	- M	739000
Objective	Function	Max.	1161214000		
Constraint	Left Hand Side	Slack or Surplus	Shadow price	Allowable Min. RHS	Allowable Max. RHS
C <sub>1</sub>	2,081,...	62,292	0	2,081,...	M
C <sub>2</sub>	834000	70,228	0	834000	M
C <sub>3</sub>	772000	0	395	711000	952000
C <sub>4</sub>	462000	0	35	405000	499000
C <sub>5</sub>	119000	255	0	119000	M
⋮			⋮		
C <sub>17</sub>	0	0	0	-M	0

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1161214000 ( )

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(R. H. S)

(L. H. S)

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	2008	2007	2006	2005	2004	2003	2002	2001	2000	/
71	142	111	89	73	60	51	44	38	33	(X <sub>1</sub> )
104	208	162	130	106	88	75	65	56	49	(X <sub>2</sub> )
151	302	235	189	154	128	109	93	81	70	(X <sub>3</sub> )
179	358	279	223	183	152	129	111	96	83	(X <sub>4</sub> )
245	489	381	305	250	208	176	112	131	114	(X <sub>5</sub> )
86	171	133	107	87	72	61	51	45	39	(X <sub>6</sub> )
129	253	197	158	129	107	91	98	67	59	(X <sub>7</sub> )
160	320	250	200	164	136	115	99	85	74	(X <sub>8</sub> )
204	407	317	254	208	173	147	126	109	95	(X <sub>9</sub> )
240	475	370	296	243	202	171	153	132	115	(X <sub>10</sub> )

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( ) 2008-2000 .

	2008	2007	2006	2005	2004	2003	2002	2001	2000	/
71	71	39	17,4	1,4	(11)	(20)	(27)	(33)	(38)	(X <sub>1</sub> )
104	103	58	25,3	1,9	(16)	(29)	(39)	(48)	(55)	(X <sub>2</sub> )
151	150	84	38	2,7	(23)	(42)	(58)	(70)	(81)	(X <sub>3</sub> )
179	178	99,6	44	3,6	(27)	(50)	(68)	(83)	(96)	(X <sub>4</sub> )
245	244	136	60	4,9	(38)	(69)	(93)	(114)	(131)	(X <sub>5</sub> )
86	85	48	21	1,7	(13)	(24)	(33)	(40)	(46)	(X <sub>6</sub> )
129	124	68	29	3,4	(22)	(38)	(30)	(61)	(70)	(X <sub>7</sub> )
160	128	88	39	3,2	(25)	(45)	(61)	(74)	(86)	(X <sub>8</sub> )
204	203	113	50	4,1	(31)	(57)	(78)	(95)	(109)	(X <sub>9</sub> )
240	235	131	56,6	3,3	(38)	(68)	(87)	(108)	(125)	(X <sub>10</sub> )

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(R<sub>1</sub>- R<sub>17</sub>) .(6)

(R<sub>18</sub>- R<sub>26</sub>)

.2008

(R<sub>27</sub>)

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$$\text{Minimize } (z) = 0X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + X_{11} + X_{12} + X_{13} + X_{14} + X_{15} + X_{16} + X_{17} + X_{18} + X_{19}$$

Subject to:

$$R_1 = 189X_1 + 347X_2 + 493X_3 + 891X_4 + 922X_5 + 295X_6 + 501X_7 + 615X_8 + 876X_9 + 1091X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \leq 2143434$$

$$R_2 = 83X_1 + 145X_2 + 217X_3 + 291X_4 + 492X_5 + 52X_6 + 123X_7 + 231X_8 + 396X_9 + 810X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \leq 904495$$

$$R_3 = 101X_1 + 125X_2 + 286X_3 + 183X_4 + 253X_5 + 163X_6 + 238X_7 + 232X_8 + 263X_9 + 314X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \leq 771989$$

$$R_5 = 42X_1 + 4X_2 + 10X_3 + 156X_4 + 217X_5 + 37X_6 + 76X_7 + 107X_8 + 153X_9 + 230X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \leq 347027$$

$$R_6 = 41X_1 + 106X_2 + 144X_3 + 229X_4 + 297X_5 + 66X_6 + 149X_7 + 195X_8 + 265X_9 + 400X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \leq 601767$$

$$R_7 = 189X_1 + 255X_2 + 288X_3 + 440X_4 + 642X_5 + 314X_6 + 470X_7 + 622X_8 + 743X_9 + 1016X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \leq 1358431$$

$$R_8 = X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_9 = 0X_1 + X_2 + 0X_3 + 0X_4 + 0X_5 + 0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$



$$R_{10} = 0X_1 + 0X_2 + X_3 + 0X_4 + 0X_5 + 0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{11} = 0X_1 + 0X_2 + 0X_3 + X_4 + 0X_5 + 0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{12} = 0X_1 + 0X_2 + 0X_3 + 0X_4 + X_5 + 0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{13} = 0X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{14} = 0X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 0X_6 + X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{15} = 0X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 0X_6 + 0X_7 + X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{16} = 0X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 0X_6 + 0X_7 + 0X_8 + X_9 + 0X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{17} = 0X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 0X_6 + 0X_7 + 0X_8 + 0X_9 + X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{18} = -38054X_1 - 55455X_2 - 80961X_3 - 95919X_4 - 131018X_5 - 45904X_6 - 70007X_7 - 85735X_8 - 109024X_9 - 124881X_{10} + X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{19} = -33086X_1 - 48128X_2 - 70418X_3 - 83421X_4 - 113946X_5 - 39834X_6 - 61175X_7 - 74564X_8 - 94816X_9 - 107695X_{10} + 0X_{11} + X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{20} = -27135X_1 - 39330X_2 - 57761X_3 - 68416X_4 - 93452X_5 - 32667X_6 - 30571X_7 - 61152X_8 - 77758X_9 - 87085X_{10} + 0X_{11} + 0X_{12} + X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{21} = - 19958X_1 - 29409X_2 - 42499X_3 - 50305X_4 - 68739X_5 - 24025X_6 - 37785X_7 - 44980X_8 - 57389X_9 - 68277X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{22} = - 10912X_1 - 16158X_2 - 23260X_3 - 27518X_4 - 37588X_5 - 13132X_6 - 21668X_7 - 24595X_8 - 31261X_9 + 38017X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{23} = 1439X_1 + 1934X_2 + 2740X_3 + 3623X_4 + 4949X_5 + 1742X_6 + 339X_7 + 3241X_8 + 4143X_9 + 3301X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + X_{16} + 0X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{24} = 17389X_1 + 25298X_2 + 37637X_3 + 43834X_4 + 59873X_5 + 20949X_6 + 28756X_7 + 39183X_8 + 49856X_9 + 56653X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + X_{17} + 0X_{18} + 0X_{19} \geq 0$$

$$R_{25} = 39541X_1 + 57745X_2 + 84042X_3 + 99682X_4 + 136187X_5 + 47625X_6 + 68224X_7 + 88503X_8 + 113348X_9 + 130753X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + X_{18} + 0X_{19} \geq 0$$

$$R_{26} = 75781X_1 + 103505X_2 + 150482X_3 + 178442X_4 + 243737X_5 + 85245X_6 + 123884X_7 + 128497X_8 + 202888X_9 + 235253X_{10} + 0X_{11} + X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + X_{19} \geq 0$$

$$R_{27} = 142000X_1 + 208000X_2 + 302000X_3 + 358000X_4 + 489000X_5 + 171000X_6 + 253000X_7 + 320000X_8 + 407000X_9 + 47500X_{10} + 0X_{11} + 0X_{12} + 0X_{13} + 0X_{14} + 0X_{15} + 0X_{16} + 0X_{17} + 0X_{18} + 0X_{19} = 1161213504$$

(Q.S.B)

Simplex

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	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	..	..	X <sub>10</sub>	R.H.S.
Min.	0	0	0	0	0	..	..	0	
C <sub>1</sub>	189	347	493	891	922	..	..	1091	≤ 2143434
C <sub>2</sub>	83	145	217	291	492	..	..	810	≤ 904495
C <sub>3</sub>	101	125	286	183	253	..	..	314	≤ 771989
:	:	:	:	:	:	:	:	:	:
C <sub>7</sub>	189	255	288	440	642	..	..	1016	≤ 1358431
C <sub>8</sub>	1	0	0	0	0	..	..	0	≥ 0
C <sub>9</sub>	0	1	0	0	0	..	..	0	≥ 0
:	:	:	:	:	:	:	:	:	:
C <sub>17</sub>	0	0	0	0	0	..	..	1	≥ 0
C <sub>18</sub>	-1054	..	..	..	..	..	..	0	≥ 0
C <sub>19</sub>	-33086	..	..	..	..	..	..	0	≥ 0
C <sub>20</sub>	-27135	..	..	..	..	..	..	0	≥ 0
C <sub>21</sub>	-19958	..	..	..	..	..	..	0	≥ 0
C <sub>22</sub>	-10912	..	..	..	..	..	..	0	≥ 0
:	:	:	:	:	:	:	:	:	:
C <sub>26</sub>	70781	..	..	..	..	..	..	0	≥ 0
C <sub>27</sub>	142000	..	..	..	..	..	..	=	1161213504

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Risk ) ( ) (8 )

.(free plan

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Var.	Solution	..	..	Red.cost	..	Min.c <sub>j</sub>	Max.c <sub>j</sub>
X <sub>1</sub>	248	..	..	0	..	-M	34500
X <sub>2</sub>	3220	..	..	0	..	-	M
X <sub>3</sub>	845	..	..	0	..	-M	177900
X <sub>4</sub>	561	..	..	0	..	-M	31046
:	:	:	:	:	:	:	:
X <sub>19</sub>	0	..	..	..	..	0	M
Objective Function Min. = 1044887000							
Const.	L.H.S.	Dire.	R.H.S.	..	..	Min. R.H.S.	Max. R.H.S.
C <sub>1</sub>	2081146	≤	2143434	..	..	208..	M
C <sub>2</sub>	834267	≤	904495	..	..	834..	M
C <sub>3</sub>	771989	≤	771989	..	..	771..	776..
C <sub>4</sub>	462239	≤	462242	..	..	462..	M
:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:
C <sub>27</sub>	1161213000	=	1161..	..	..	1159..	1161..

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E

(C27 ) ( 1 ,161 , 213,000)

,044 , 887,000) ( )

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.(Objective Function Min.

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E

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.(A)

(2)

.(S.D.)

(3)

.(V)

(4)

11 5 4 2 1

:(9)

11	5	4	2	1	
6142	3270	2792	1258	248	( X <sub>1</sub> ) 11/10
0	0	0	1676	3220	( X <sub>2</sub> ) 11/25
415	805	869	885	845	( X <sub>3</sub> ) 11/40
175	1156	1319	996	561	( X <sub>4</sub> ) 11/63
1061	1121	1131	1151	1161	(E)
738	899	926	999.5	1045	( )
164	200	205	222	232	( ) (A)
218	265	273	295	309	( S.D) ( )
47524	70225	74529	87025	95481	( ) (V)

( E )

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11

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.(9 )

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222 A

87025

(V.)

295

(S.D)

	(X <sub>4</sub> 11/63) :	(X <sub>3</sub> 11/40) :	(X <sub>1</sub> 11/10)	
	(		)	
		996 885 1258		
1676	(X <sub>2</sub> 11/25)			
			(X <sub>5</sub> - X <sub>10</sub> )	
		.(9 2	)	
	1131	4		
	(S.D)	A		
		273 205	%4 %5	
869	(X <sub>3</sub> 11/40)			
	(X <sub>2</sub> 11/25)			
	(X <sub>4</sub> 11/40) (X <sub>1</sub> 11/10)			
	1319 2792			
		.(9 3	)	
	11-7			
		(S.D)	A	
	(X <sub>4</sub> 11/63) (X <sub>3</sub> 11/40)			
(X <sub>1</sub> 11/10)				
5	)		6142	
			.( 9	
	(X <sub>3</sub> 11/40)	4	(X <sub>2</sub> 11/25)	
		1		
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(X<sub>1</sub> 11/10)

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E (Trade – Off)

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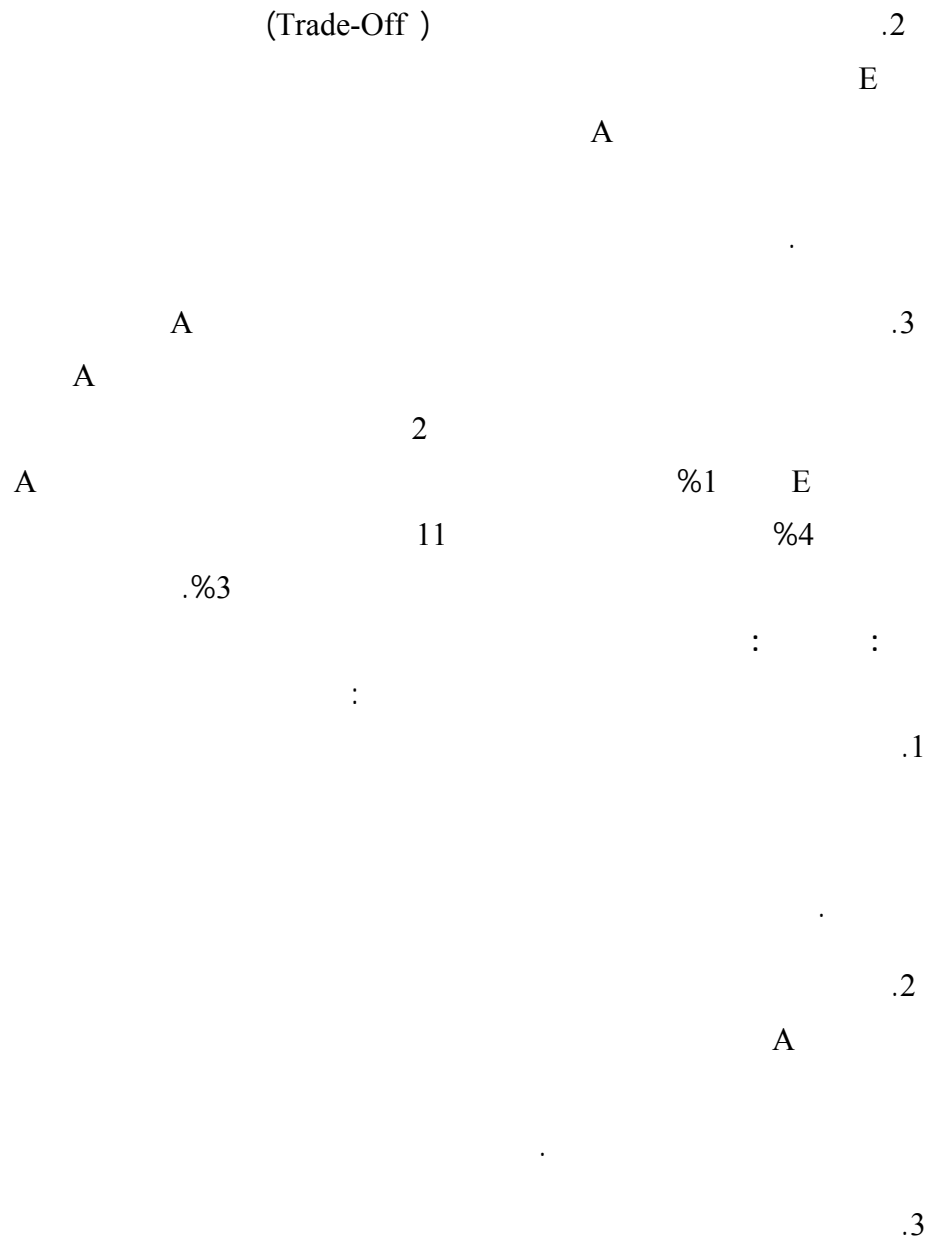
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