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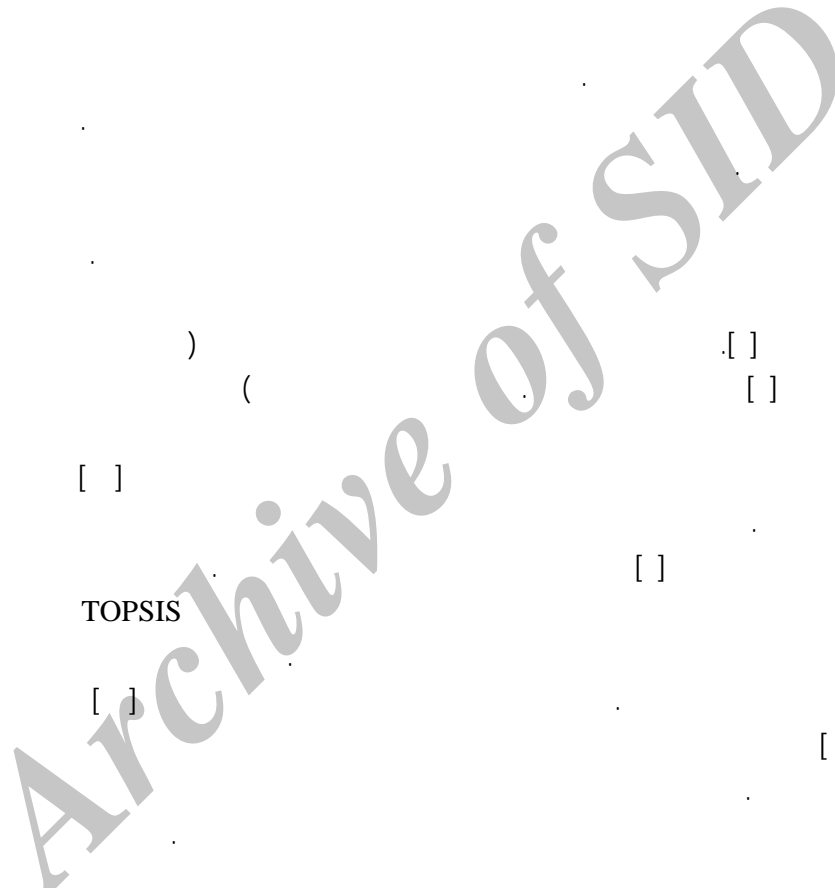
(SP/MP

(DOD)

/ / <

(SI/MI)

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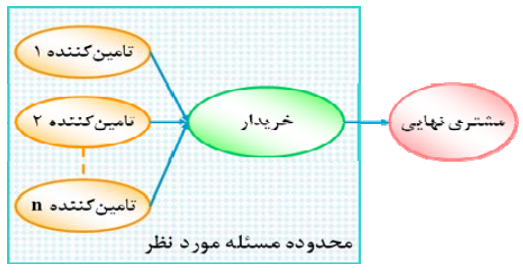
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Archive of SID

| | | | |
|-------------------|--|-----|-----|
| $(i=1,2,\dots,n)$ | n | | |
| i | $:l_i$ | | |
| i | $:a_i$ | | |
| i | $:C_i$ | | |
| i | $:A_i$ | | |
| | r | | ↖ |
| i | $:z_i$ | | ↖ |
| i | $:S_i$ | | ↖ |
| i | $:G_i$ | () | ↖ |
| | E | | ↖ |
| | F | | ↖ |
| | K | | ↖ |
| | T | () | ↖ |
| | Q | | ↖ |
| i | $:Q_i$ | | ↖ |
| | $(\sum_{i=1}^n Q_i = Q \quad Q=DT)$ | | ↖ |
| i | $:x_i$ | | ↖ |
| | $(x_i = \frac{1}{T} Q_i \sum_{i=1}^n x_i = D)$ | | |
| i | $:Y_i$ | | (1) |



$$Max \quad Z_1 = \sum_i \alpha_i x_i \quad (1)$$

$$Min \quad Z_2 = \sum_i l_i x_i \quad (2)$$

$$Min \quad Z_3 = \sum_i (C_i + z_i + (E + F)l_i + K(1 - \alpha_i))x_i + \frac{rQ}{2D^2} \sum_i C_i x_i^2 + \frac{D}{Q} \sum_i (A_i + S_i)Y_i \quad (3)$$

s.t.

$$\sum_{i=1}^n x_i = D \quad (4)$$

$$0 \leq x_i \leq G_i \quad \forall i = 1, 2, \dots, n \quad (5)$$

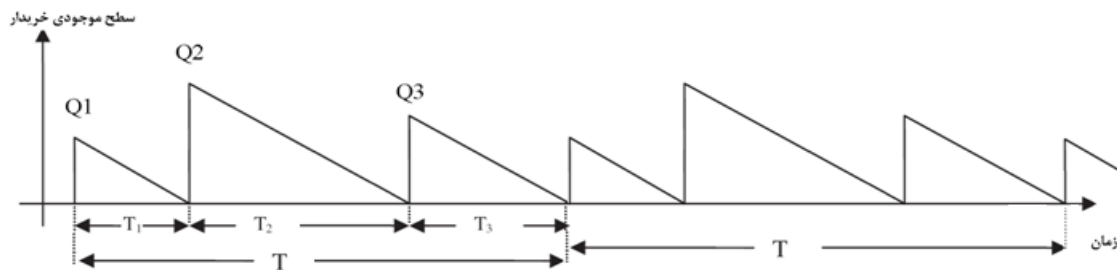
$$x_i \leq DY_i \quad \forall i = 1, 2, \dots, n \quad (6)$$

$$x_i \geq \varepsilon Y_i \quad \forall i = 1, 2, \dots, n \quad (7)$$

$$Y_i = \{0, 1\} \quad \forall i = 1, 2, \dots, n \quad (8)$$

| | |
|----------------------------|-----|
| | |
| (SO, MP, SI, WOD, Det, MS) | [] |
| (SO, MP, SI, WD, Det, MS) | [] |
| (SO, MP, SI, WD, Prb, MS) | [] |
| (MO, SP, SI, WD, Prb, MS) | [] |
| (MO, MP, MI, WD, Det, MS) | [] |
| (SO, MP, SI, WOD, Det, MS) | [] |
| (MO, MP, MI, WOD, Det, MS) | [] |

| | |
|------------------------------------|-------------------------------|
| $\sum_i C_i x_i$ | $\sum_i z_i x_i$ |
| $\frac{D}{Q} \sum_i A_i Y_i$ | $\frac{D}{Q} \sum_i S_i Y_i$ |
| $\frac{rQ}{2D^2} \sum_i C_i x_i^2$ | $E \sum_i l_i x_i$ |
| $F \sum_i l_i x_i$ | $K \sum_i (1 - \alpha_i) x_i$ |



$$\frac{\partial Z_3}{\partial Q} = 0 \Rightarrow Q^* = \sqrt{\frac{2D^3 \sum_i (A_i + S_i) Y_i}{r \sum_i C_i x_i^2}}$$

$$\text{Max } Z_1 = \sum_i \alpha_i x_i \quad (1)$$

$$\text{Min } Z_2 = \sum_i l_i x_i \quad (2)$$

$$\text{Min } Z_3 = \sum_i (C_i + z_i + (E + F)l_i + K(1 - \alpha_i))x_i + \sqrt{\frac{2r}{D} \sum_i (A_i + S_i) Y_i} \times \sqrt{\sum_i C_i x_i^2} \quad (3)$$

s.t.

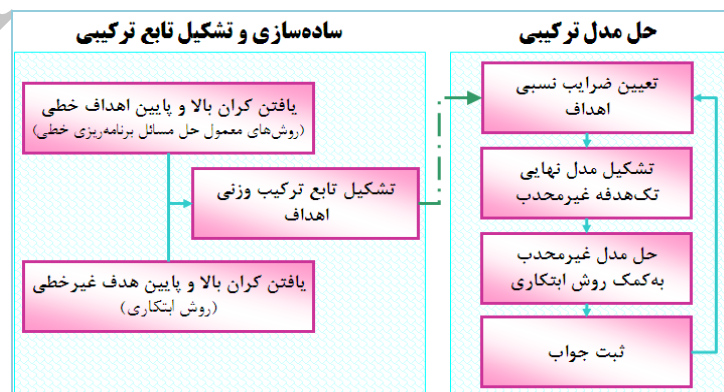
$$\sum_{i=1}^n x_i = D \quad \text{Problem (P)} \quad (4)$$

$$0 \leq x_i \leq G_i \quad \forall i = 1, 2, \dots, n \quad (5)$$

$$x_i \leq D Y_i \quad \forall i = 1, 2, \dots, n \quad (6)$$

$$x_i \geq \varepsilon Y_i \quad \forall i = 1, 2, \dots, n \quad (7)$$

$$Y_i = \{0, 1\} \quad \forall i = 1, 2, \dots, n \quad (8)$$



$$\begin{aligned}
 & x_i \\
 & (y_i) \\
 & [] \\
 & y_i \\
 & [] \\
 & n \\
 & n \quad ([] [] [] y_i)
 \end{aligned}$$

NP-Hard
 NP-Hard
 ([])

$$\begin{aligned}
 & y_i \\
 & [] \\
 & (w_1, w_2, \dots, w_k)
 \end{aligned}$$

$$\begin{aligned}
 & P_1 \\
 & Z_i^- \quad Z_i^+ \quad P_1
 \end{aligned}$$

$$\begin{aligned}
 \text{Min } Z(X) &= w_1 \left(\frac{Z_1^+ - Z_1}{Z_1^+ - Z_1^-} \right) + w_2 \left(\frac{Z_2 - Z_2^-}{Z_2^+ - Z_2^-} \right) + w_3 \left(\frac{Z_3 - Z_3^-}{Z_3^+ - Z_3^-} \right) \quad () \\
 \text{s.t. } & \\
 Z_1 &= \sum_i \alpha_i x_i \quad () \\
 Z_2 &= \sum_i l_i x_i \quad () \\
 Z_3 &= \sum_i (C_i + z_i + (E + F)l_i + K(1 - \alpha_i))x_i + \sqrt{\frac{2r}{D} \sum_i (A_i + S_i)Y_i} \times \sqrt{\sum_i C_i x_i^2} \quad () \\
 \sum_{i=1}^n x_i &= D \quad \text{Problem } (P_1) \quad () \\
 0 \leq x_i &\leq G_i \quad \forall i = 1, 2, \dots, n \quad () \\
 x_i &\leq DY_i \quad \forall i = 1, 2, \dots, n \quad () \\
 x_i &\geq \varepsilon Y_i \quad \forall i = 1, 2, \dots, n \quad () \\
 Y_i &= \{0, 1\} \quad \forall i = 1, 2, \dots, n \quad ()
 \end{aligned}$$

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Matlab

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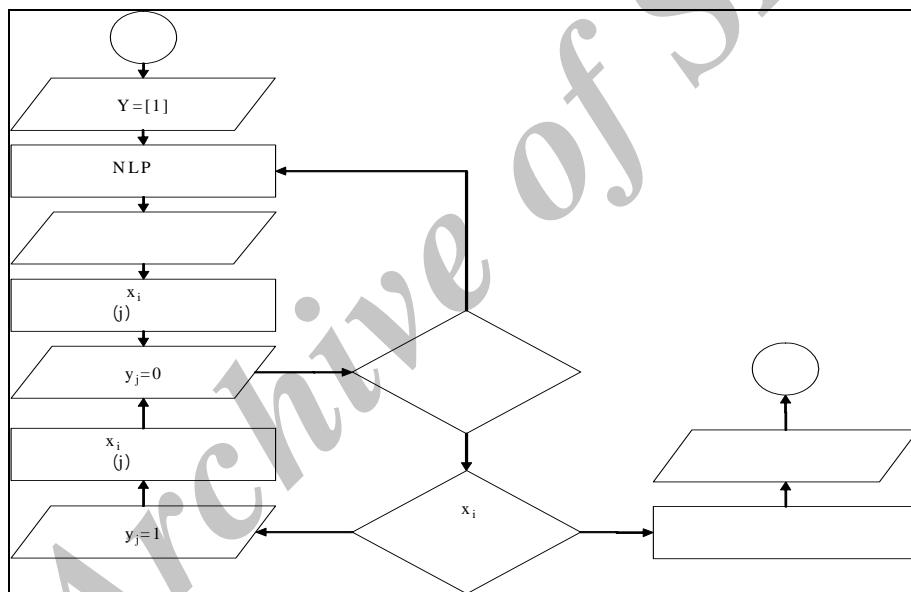
(

) n

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E = 65
F = 35
K = 40

r = 0.25
 $\epsilon = 10^{-14}$



D n

| n | D | Feasible Nodes | Elapsed Time (Sec) | |
|----|------|----------------|--------------------|-----------|
| | | | Exact | Heuristic |
| 3 | 1000 | 4 | 2.79 | 2.21 |
| 4 | 1600 | 5 | 2.97 | 2.74 |
| 5 | 1800 | 9 | 2.42 | 2.03 |
| 6 | 2000 | 22 | 3.12 | 2.26 |
| 7 | 2300 | 52 | 5.37 | 2.24 |
| 9 | 3000 | 136 | 13.752 | 2.27 |
| 11 | 3600 | 543 | 61.45 | 2.57 |
| 13 | 4100 | 2436 | 319.18 | 2.64 |
| 15 | 4300 | 13148 | 1937.4 | 3.32 |
| 17 | 5000 | 43977 | 8114.35 | 3.7 |
| 18 | 5700 | 53644 | 9977.52 | 3.68 |

P₁

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(

P₁

(n=60)

(D=19500)

(Z)

$$\begin{aligned}
 E &= 65 & r &= 0.25 \\
 F &= 35 & \varepsilon &= 10^{-14} \\
 K &= 40 & &
 \end{aligned}$$

P₁

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(Z)

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(Z)

P₁

:()

P₁

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() () ()

(Z)

"()

$$Z = w_1 \left(\frac{Z_1^+ - Z_1^-}{Z_1^+ - Z_1^-} \right) + w_2 \left(\frac{Z_2^+ - Z_2^-}{Z_2^+ - Z_2^-} \right) + w_3 \left(\frac{Z_3^+ - Z_3^-}{Z_3^+ - Z_3^-} \right) ()$$

()

(Z)

()

$$\text{Max } Z_1^2 = \sum_i \alpha_i x_i \quad ()$$

$$\text{Min } Z_2^2 = \sum_i l_i x_i \quad ()$$

$$\text{Min } Z_3^2 = \sum_i (z_i + El_i + K(1 - \alpha_i))x_i + \frac{D}{Q} \sum_i S_i Y_i$$

$$\text{s.t.} \quad ()$$

$$\sum_{i=1}^n x_i = D \quad ()$$

$$0 \leq x_i \leq G_i \quad \forall i = 1, 2, \dots, n \quad ()$$

$$x_i \leq DY_i \quad \forall i = 1, 2, \dots, n \quad ()$$

$$x_i \geq \varepsilon Y_i \quad \forall i = 1, 2, \dots, n \quad ()$$

$$Y_i = \{0, 1\} \quad \forall i = 1, 2, \dots, n \quad ()$$

x_i

$$\sum_i (C_i + Fl_i)x_i + \frac{r}{2D} \sum_i C_i x_i^2 + \sum_i A_i Y_i \quad ()$$

$$Q=D$$

$$()$$

$$()$$

$$()$$

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$$()$$

[]

$$() () ()$$

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$$()$$

Q

D

$$()$$

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$$\text{Max } Z_1^1 = \sum_i \alpha_i x_i \quad ()$$

$$\text{Min } Z_2^1 = \sum_i l_i x_i \quad ()$$

$$\text{Min } Z_3^1 = \sum_i (C_i + Fl_i)x_i + \frac{rQ}{2D^2} \sum_i C_i x_i^2 + \frac{D}{Q} \sum_i A_i Y_i \quad ()$$

s.t.

$$\sum_{i=1}^n x_i = D \quad ()$$

$$0 \leq x_i \leq G_i \quad \forall i = 1, 2, \dots, n \quad ()$$

$$x_i \leq DY_i \quad \forall i = 1, 2, \dots, n \quad ()$$

$$x_i \geq \varepsilon Y_i \quad \forall i = 1, 2, \dots, n \quad ()$$

$$Y_i = \{0, 1\} \quad \forall i = 1, 2, \dots, n \quad ()$$

x_i

:

$$\sum_i (z_i + El_i + K(1 - \alpha_i))x_i + \frac{D}{Q} \sum_i S_i Y_i \quad ()$$

$$()$$

$$()$$

$$()$$

$$()$$

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$$\bar{D} = -0.05039 \Rightarrow t = -15.5938$$

$$S_D = 0.043711$$

t

α

$$(-\infty, 1.645]$$

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() ()

n-1

$$t = \frac{\bar{D}\sqrt{n}}{S_D}$$

S_D

\bar{D}

$$S_D = \sqrt{\frac{\sum_{i=1}^n (D_i - \bar{D})^2}{n-1}}$$

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A

H

$$H : D = 0$$

$$A : D > 0$$

$$(-\infty, t_{\alpha; n-1}]$$

$t_{\alpha; n-1}$

$$\alpha = 0.05$$

$$t_{0.05, 182} = 1.645$$

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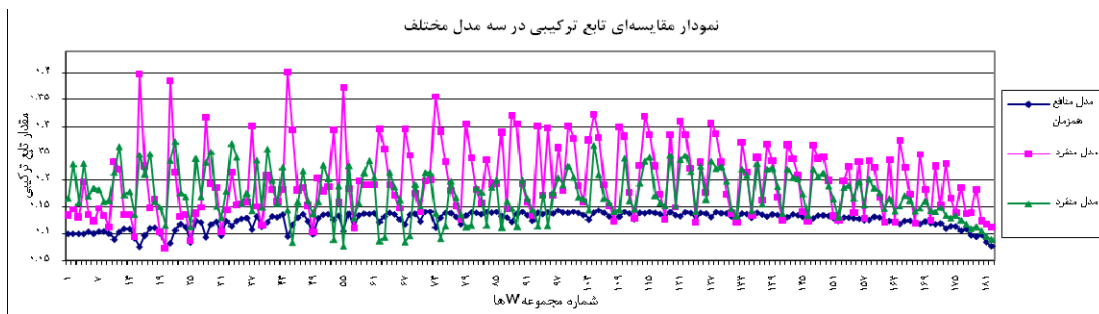
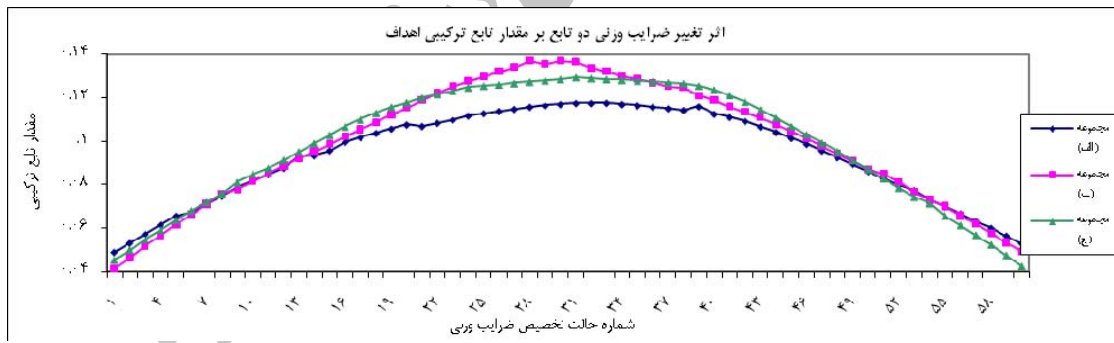
$$\bar{D} = -0.07523$$

$$\Rightarrow t = -15.2786$$

$$S_D = 0.066611$$

۱ برای مطالعه بیشتر به بخش ۷ و همچنین غازی مرجع [۲۷] مراجعه نمایید.

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- 1- Supplier Selection
- 2- Vendor Selection
- 3- National Bureau of Standards
- 4- Department Of Defense
- 5- Joint Economic Lot-sizing Problem
- 6- (CPU: AMD 2800+) & (RAM: 512 MB)

| (i) Supplier Number | C_i | L_i | $Alfa_i$ | G_i | z_i | A_i | S_i |
|---------------------|-------|-------|----------|-------|-------|-------|-------|
| 1 | 112 | 0.05 | 0.98 | 570 | 93 | 7450 | 9800 |
| 2 | 118 | 0.08 | 0.94 | 670 | 89 | 6120 | 9400 |
| 3 | 114 | 0.02 | 0.96 | 450 | 90 | 6590 | 8600 |
| 4 | 117 | 0.04 | 0.97 | 590 | 91 | 6890 | 9300 |
| 5 | 119 | 0.01 | 0.97 | 610 | 90 | 6410 | 8970 |
| 6 | 120 | 0.01 | 0.99 | 590 | 89 | 6700 | 9100 |
| 7 | 111 | 0.07 | 0.95 | 640 | 92 | 6300 | 9500 |
| 8 | 115 | 0.05 | 0.96 | 470 | 86 | 7100 | 9210 |
| 9 | 108 | 0.01 | 0.98 | 360 | 88 | 7800 | 9700 |
| 10 | 127 | 0.01 | 0.99 | 680 | 86 | 6320 | 9460 |
| 11 | 113 | 0.02 | 0.95 | 370 | 85 | 7430 | 8920 |
| 12 | 119 | 0.01 | 0.98 | 460 | 88 | 6210 | 9310 |
| 13 | 117 | 0.04 | 0.97 | 640 | 94 | 6030 | 9000 |
| 14 | 117 | 0.09 | 0.93 | 420 | 91 | 6320 | 9530 |
| 15 | 118 | 0.02 | 0.96 | 530 | 90 | 6490 | 9620 |
| 16 | 111 | 0.06 | 0.99 | 610 | 88 | 7310 | 9700 |
| 17 | 125 | 0.05 | 0.94 | 370 | 87 | 7000 | 9900 |
| 18 | 128 | 0.06 | 0.92 | 430 | 89 | 7040 | 9510 |
| 19 | 112 | 0.08 | 0.93 | 510 | 90 | 6910 | 9010 |
| 20 | 110 | 0.04 | 0.98 | 610 | 92 | 6520 | 8510 |
| 21 | 126 | 0.05 | 0.96 | 700 | 87 | 6050 | 8490 |
| 22 | 121 | 0.02 | 0.95 | 630 | 85 | 7360 | 8670 |
| 23 | 126 | 0.03 | 0.94 | 600 | 93 | 6710 | 8930 |
| 24 | 127 | 0.08 | 0.92 | 520 | 86 | 6800 | 9780 |
| 25 | 118 | 0.07 | 0.93 | 500 | 89 | 6530 | 9460 |
| 26 | 115 | 0.1 | 0.94 | 610 | 93 | 6490 | 9810 |
| 27 | 116 | 0.06 | 0.95 | 360 | 92 | 7080 | 9020 |
| 28 | 118 | 0.1 | 0.91 | 380 | 94 | 7210 | 8670 |
| 29 | 120 | 0.04 | 0.93 | 390 | 87 | 6620 | 8460 |
| 30 | 129 | 0.09 | 0.98 | 490 | 91 | 7090 | 9120 |
| 31 | 121 | 0.01 | 0.97 | 470 | 86 | 7420 | 9240 |
| 32 | 127 | 0.04 | 0.98 | 610 | 98 | 6260 | 8620 |
| 33 | 115 | 0.05 | 0.95 | 520 | 89 | 7150 | 9510 |
| 34 | 119 | 0.09 | 0.96 | 460 | 87 | 6540 | 8450 |
| 35 | 115 | 0.03 | 0.92 | 790 | 97 | 7480 | 9840 |
| 36 | 129 | 0.02 | 0.91 | 570 | 86 | 6870 | 9740 |
| 37 | 117 | 0.04 | 0.94 | 390 | 94 | 6390 | 9980 |
| 38 | 114 | 0.07 | 0.98 | 640 | 95 | 6330 | 8360 |
| 39 | 113 | 0.06 | 0.96 | 790 | 89 | 7610 | 9130 |
| 40 | 126 | 0.02 | 0.95 | 460 | 92 | 6520 | 8220 |
| 41 | 128 | 0.05 | 0.92 | 590 | 85 | 7580 | 8840 |
| 42 | 124 | 0.01 | 0.93 | 680 | 87 | 6970 | 8770 |
| 43 | 123 | 0.08 | 0.93 | 540 | 86 | 7250 | 9560 |
| 44 | 120 | 0.09 | 0.99 | 480 | 98 | 7530 | 9320 |
| 45 | 120 | 0.03 | 0.96 | 630 | 97 | 7420 | 8240 |
| 46 | 118 | 0.01 | 0.95 | 540 | 92 | 6990 | 9960 |
| 47 | 129 | 0.04 | 0.98 | 720 | 93 | 6640 | 8830 |
| 48 | 122 | 0.07 | 0.94 | 740 | 92 | 7980 | 9390 |
| 49 | 119 | 0.08 | 0.91 | 730 | 84 | 7360 | 8330 |
| 50 | 116 | 0.02 | 0.98 | 490 | 95 | 6230 | 9620 |
| 51 | 118 | 0.03 | 0.96 | 380 | 89 | 7720 | 9570 |
| 52 | 125 | 0.06 | 0.95 | 540 | 98 | 6240 | 8720 |
| 53 | 116 | 0.05 | 0.93 | 800 | 87 | 6270 | 8920 |
| 54 | 127 | 0.04 | 0.98 | 460 | 97 | 6730 | 9210 |
| 55 | 117 | 0.07 | 0.98 | 690 | 85 | 7120 | 8510 |
| 56 | 115 | 0.08 | 0.96 | 720 | 96 | 7340 | 9430 |
| 57 | 116 | 0.02 | 0.93 | 390 | 82 | 6560 | 8950 |
| 58 | 123 | 0.03 | 0.98 | 710 | 91 | 6430 | 9640 |
| 59 | 124 | 0.01 | 0.98 | 450 | 89 | 7220 | 8220 |
| 60 | 120 | 0.09 | 0.96 | 550 | 99 | 6810 | 9180 |

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

Archives SID