Optimum Tolerance Synthesis for Complex Assembly with Alternative Process Selection Using Bottom Curve Follower Approach

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Abstract

Components cannot be manufactured according to the required nominal dimensions due to inherent variations in workmanship, materials and machine tools. Tolerance specification of part dimensions affects the performance, quality and cost of a product. The proper distribution of tolerance, known as tolerance allocation, reduces the manufacturing cost of a product. Thus, researchers in this field are keenly interested in tolerance allocation. The choice of alternative processes for tolerance allocation also plays a vital role in reducing manufacturing costs. Near-optimal allocated tolerances are obtained using non-traditional optimization techniques, in which solutions are randomly achieved. However, there is the possibility that a better allocation process will not be discovered because the randomness of the results of successive runs will not yield consistent results. In this work, an attempt has been made to solve the above problem using the Lagrange multiplier (LM) method for complex assembly and the bottom curve follower approach. The methodology has been demonstrated on a wheel mounting assembly. Compared to Singh's method [14], a 1.95% savings in manufacturing cost was achieved after implementing the proposed method. The present method was 30 times faster than the existing methods.

Keywords: Tolerance allocation, optimization techniques, alternative process selection, Lagrange's multiplier method, bottom curve follower approach.

1. INTRODUCTION

A manufacturer cannot survive in the global market if he fails to supply customers with high-quality, maintenance-free products that are attractively priced. On the engineering design side, the specification of tolerance affects the fit and performance of the final product. On the manufacturing side, it affects the selection of machines, tooling and fixtures, operator skill levels, setup costs, the precision of inspection instruments, gauging, the amount of scrap and the amount of rework needed. Generally speaking, the smaller the tolerance, the higher the manufacturing costs and the greater the tolerance, the lower the manufacturing costs. Overall manufacturing costs can be reduced without a great deal of overhead by properly allocating tolerances among the components of an assembly.

Moy introduced simultaneous selection of optimal tolerances by considering discrete cost functions and their manufacturing processes [1]. Loosli developed several methods for tolerance allocation of simple assemblies, which greatly increases the likelihood of finding the absolute minimum cost. The author concluded that the exhaustive search method is the only method that results in global minimal assembly tolerance costs. When this occurs, computing resources are unlimited. If the combination of process exceeds 50, the univariate search method will give the best result. The author also recommended developing a better method to determine the optimum cost when upper and lower process tolerance constraints are applied. He also proposed using the simulated annealing method to solve combinatorial problems [2]. Lee and Woo worked on branch and bound algorithms and reported the selection of optimal tolerances by incorporating a discrete cost function for both linear and nonlinear assemblies with process limits and interrelated dimension chains [3]. Chase et al. presented their results using an exhaustive search, a univariate search and sequential quadratic programming methods to allocate tolerances optimally with the help of a discrete and continuous cost function [4]. Zhang and Wang developed an analytical model for simultaneously allocating design and machining tolerances based on the least manufacturing cost criterion, and formulated tolerance allocation as a nonlinear optimization model based on the cost tolerance relationship in which the author employed a simulated annealing algorithm [5]. Vasseur et al. attempted to determine statistical tolerances by formulating a continuous cost function using a simulated annealing algorithm, taking into account manufacturing costs and quality loss.

Tolerance allocation is the design tool for reducing overall manufacturing costs by systematically redistributing the tolerance budget within an assembly, tightening tolerances on less expensive processes and loosening the tolerance on costly processes [6]. Wu and Tang computed average quality losses of batch products in a different manner, according to the distribution of functional characteristics. They presented a design method for allocating dimensional tolerances of products with asymmetric quality losses [7]. Chase described a detailed algorithm for automatically performing tolerance allocation (loosening tolerance on costlier processes and tightening tolerance on less costly processes) based on an optimization technique [8]. He assumed that the cost versus tolerance data available for each dimension and also each component has an alternative manufacturing process. The author compared discrete and continuous optimization to an exhaustive search based on CPU time and the number of combinations required to find a global optimum. The author concluded that the exhaustive search method is the most reliable procedure to find the global minimum when large computing facilities are available. The zero-one method is too inefficient from practical value. A branch and bound algorithm is more efficient, but requires several discrete points, as closed as for each cost tolerance curve. Sequential quadratic programming (SQP) is capable of treating the multiple loop assembly function, but cannot guarantee the global minimum. The univariate search method is the most efficient of the processes tested by a wide margin and requires a special procedure for handling process limits [9]. Ji et al. described a new approach based on fuzzy comprehensive evaluation and a genetic algorithm to obtain a rational tolerance allocation for the parts. In the tolerance allocation, the machinability, which depends on the fuzzy comprehensive evaluation and the function sensitivity factor, is considered. Design ideas for assembly and manufacturing are also included.

Tolerance allocation affects product design, manufacturing and quality [10]. Ye constructed a nonlinear optimization model to implement a new concurrent engineering method for tolerance allocation. His method produced the best result and is well suited to engineering environments where either high-quality or low-cost products are designed and manufactured. Statistical tolerance synthesis eliminates the need for various intermediate results, thus improving computability and making it easier for design and manufacturing engineers to understand a model.

Conventional tolerance allocation is based on solutions derived from common practice or previous experience [11]. Carfagni et al. presented a methodology to allow automatic tolerance allocation capable of minimizing the manufacturing costs of parts. The authors used a Monte Carlo simulation to compute the statistical distribution of control measurement and employed a genetic algorithm as an optimization technique. Their method allows a global approach to tolerance allocation problems. The authors proved that the methodology is a powerful tool for automatically optimizing a user-defined tolerance set. Assigning a dimension tolerance either in drawings or in CAD models has an enormous impact on cost and quality [12]. Diplaris and Sfantsikopoulos formulated a new analytical cost tolerance model that produces results closer to industrial practice based on available industrial knowledge and earlier published data [13]. Singh et al. introduced a genetic algorithm to obtain a global optimal solution to the advanced tolerance synthesis problem by considering the continuous cost function [14]. Prabhaharan et al. used a genetic algorithm for optimal tolerance allocation to help design and manufacturing engineers overcome the shortcomings in the conventional tolerance stack analysis and allocation system [15]. They introduced a continuous ant colony algorithm, a kind of meta-heuristic approach, as an optimization tool for minimizing the critical dimension deviation and allocating cost-based optimal tolerances [16]. Huang and Shiau obtained the optimized tolerance allocation of a sliding vane rotary compressor’s components for required reliability with minimal cost and quality loss [17]. Siva Kumar et al. constructed closed-form equations for optimum tolerance allocation of simple assemblies [18]. Siva Kumar et al. developed a hybrid algorithm (Heuristics + Tabu search) for optimum tolerance allocation of complex assemblies with alternative processes selection [19].To the best of our knowledge, there is no literature available to obtain the optimum allocated tolerance of complex assemblies with alternative process selection using the Lagrange multiplier (LM) method with bottom curve follower approach. The manufacturers are looking for a noval method to reduce the manufacturing cost inturn to earn more profit from their products. The objective of this paper is to develop a noval method to reduce the manufacturing cost. This is achieved by introducing bottom curve follower method for the best process selection and LM method to obtain the optimum allocated tolerance of the components of a complex assembly.

2. THE PROBLEM

The customer (not the manufacturer) fixes the cost of a product based on heavy competition in the international market. The cost of a product is nothing but the sum of the manufacturing cost and the manufacturer’s profit. To get more profit, the manufacturer has to reduce manufacturing costs. Manufacturers desperately need methods that result in products with minimal manufacturing costs. Tolerance specifications play a major role in manufacturing costs because lower tolerance results in lower manufacturing costs and higher tolerance results in higher manufacturing costs. Proper allocation of tolerance among the components of a mechanical assembly will significantly reduce manufacturing costs. The global optimum allocated tolerances of components are obtained using the LM method in simple assemblies without alternative process selection. Non-traditional optimization techniques have been used to obtain near-optimal allocated tolerance of components in complex assemblies with alternative process selection, in which the results/solutions are obtained randomly via a number of trials/iterations. With these techniques, there is a possibility of omit a better process for optimum tolerance allocation.

3. METHODOLOGY

To achieve the global optimum allocated tolerance for the components of a complex assembly (interrelated dimensional chain product) with an alternative process selection, the bottom curve follower approach is introduced to select the best process. The LM method is used as an optimization technique. The methodology is demonstrated using a wheel mounting assembly (Singh et al.).

3.1 Lagrange's multiplier method

This is the best efficient method for allocating the tolerances for single process optimization problem. This method eliminates the need for multiple-parameter iterative solutions and allows alternative cost-tolerance models. It can handle either worst case or statistical assembly models. The designer must check the resulting component tolerances to make ensure they are within the process tolerance range. An exponential constant cost model gives results closer to the real values when calculating manufacturing cost for given tolerance values.

$$\frac{\partial}{\partial t_i}[tc\_fun] + \lambda \frac{\partial}{\partial t_i}[asy\_cont] = 0 \qquad (1)$$

where

tc_fun	- Tolerance cost function
asy_cont	- Assembly constraint

3.1.1 Mathematical model for tolerance cost computation

Exponential cost function model (Singh et al.) is considered for calculating the tolerance cost. An individual component's tolerance cost (MC_i) and the total manufacturing cost / tolerance cost ($Cost_{asm}$) of the product are estimated using the expressions (2) and (3).

$$MC_i = C0_i \times \exp(-C1_i \times t_i) + C2_i \qquad (2)$$

$$Cost_{asm} = \sum_{i=1}^{n} MC_i \qquad (3)$$

where

C0,C1 & C2	- Exponential cost model constants
t	- Tolerance in mm
i	- Component index
n	- Number of components in an assembly

3.1.2 Mathematical model for tolerance estimation

Allocating tolerance to components of a complex assembly worst case model is considered in this work. Assembly tolerance (t_{asm}) and the individual component's tolerance (detailed derivation is shown in section A.1 - Appendix A) are determined using equations (4) and (5).

$$t_{asm} = \sum_{i=1}^{n} t_i \qquad (4)$$

$$t_{i+1} = \frac{\log\left[\dfrac{C0_{i+1} \times C1_{i+1} \times \exp(C1_i \times t_i)}{C0_i \times C1_i}\right]}{C1_{i+1}} \qquad (5)$$

3.1.3 Constraints

Two constraints to be obtaining the optimum tolerance allocation are given in expressions (6) and (7). The expression (6) represents that the sum of allocated tolerance of the components must be less than or equal to assembly tolerance value. Expression (7) implies that the allocated tolerance must lie between the upper (t_U) and lower process tolerance limit (t_L) of the component.

$$t_{asm} >= \sum_{i=1}^{n} t_i \qquad (6)$$

$$t_{Li} \leq t_i \leq t_{Ui} \qquad (7)$$

3.2 Bottom curve follower approach

Figure 1 represents the concept of the bottom curve follower approach. For the tolerance tA, the process number P3 has less tolerance cost, since P3 is in the bottom position. Similarly, for the tolerance tB, the process number P1 has less tolerance cost. Compared with nontraditional optimization techniques, this method will yield results quickly. Any one of the alternative processes is randomly selected for each component. The optimum allocated tolerances are then obtained using the LM method. The manufacturing cost of the components is computed for each component, each with its alternative process. The least-cost alternative process is selected for each component and the optimum allocation of tolerance is carried out again. The procedure is repeated again and again until there is no change in the alternative process of each component. The least-cost processes are selected for the manufacturing of components. The detailed algorithm is presented in the next section and the flow chart is shown in Figure A.1 (Appendix A).

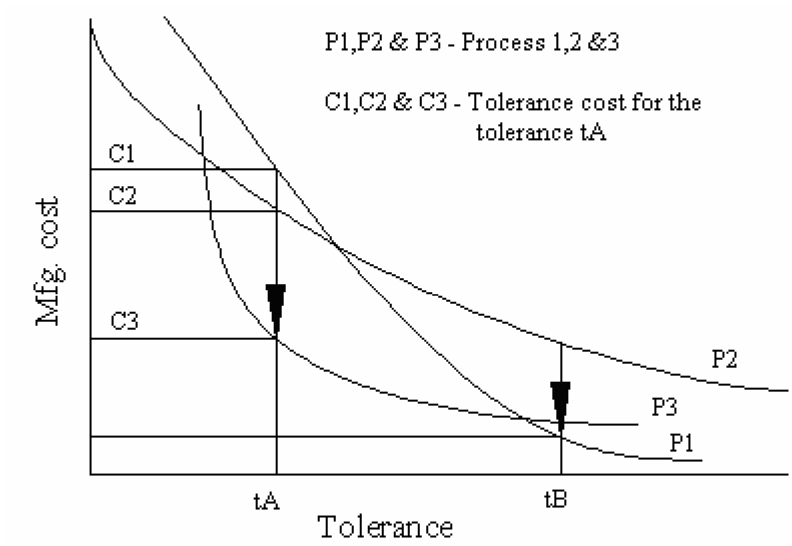

FIGURE 1: Bottom curve follower approach.

3.2.1 Algorithm - bottom curve follower approach

Step 1 : Read number of components (n) and assembly tolerances ($t_{asm1}$and t_{asm2})
Step 2 : Set i = 1
Step 3 : Read number of process for each component (nop[i])
Step 4 : Increment i by 1
Step 5 : If (i<=n)
Go to step 3
Step 6 : Set i = 1
Step 7 : Set j = 1
Step 8 : Read C0[i][j],C1[i][j],C2[i][j],t_{min}[i][j] and t_{max}[i][j]
Step 9 : Increment j by 1
Step 10: If (j<=nop[i])

Go to step 8
Step 11: Increment i by 1
Step 12: If (i <= n)
Go to step 7
Step 13: Set i = 1
Step 14: Generate a random number (pno[i]) within nop[i]
Step 15: Increment i by 1
Step 16: If (i <= n)
Go to step 14
Step 17: Initialize t_s = max(t_{min}[][])
Step 18: Initialize i = 1 and t [i][pno[i]] =t_s
Step 19: Compute t[i+1][pno[i+1]] using

$$t\,[i+1][pno[i+1]] = \frac{\log\left[\dfrac{C0[i+1][pno[i+1]]\times C1[i+1][pno[i+1]]\times \exp(C1[i][pno[i]]\times t\,[i][pno[i]])}{C0[i][pno[i]]\times C1[i][pno[i]]}\right]}{C1[i+1][pno[i+1]]}$$

Step 20: If ((t[i+1][pno[i+1]]) <t_{min}[i+1][pno[i+1]]) OR (t[i+1]>t_{max}[i+1][pno[i+1]]))
Go to step 29
Step 21: Increment i by 1
Step 22: If (i<=n-1) then
Go to step 19
Step 23: Set i=1 and t_{casm}=0
Step 24: t_{casm}=t_{casm} + t[i][pno[i]]
Step 25: Increment i by 1
Step 26: If (i < n-1)
Go to step 24
Step 27: diff=100 x abs(t_{casm}-t_{asm1})/t_{casm}
Step 28: If (diff <= 0.000001)
Go to step 30
Step 29: t_s = t_s + 0.00001 and Go to step 18
Step 30: Determine t[n][pno[n]] using t[n] [pno[n]]=t_{asm2} - t[n-1][pno[n-1]]
Step 31: Initialize i = 1, and cost = 0
Step 32: $MC[i][pno[i]] = C0[i][pno[i]]\times \exp(-C1[i][pno[i]]\times t\,[i][pno[i]]) + C2[i][pno[i]]$
Step 33: Compute cost = cost + MC[i][pno[i]]
Step 34: Display allocated tolerance t[i][pno[i]] and its manufacturing cost MC[i][pno[i]]
Step 35: Increment i by 1
Step 36: If (i<=n)
Go to step 32
Step 37: Display t[][],MC[][] and cost of the product.
Step 38: Set i = 1,k=0, itr=1 and tcost [itr]= 0
Step 39: Set j=1
Step 40: Compute cst[i][j]=C0[i][j] x exp(-t [i][pno[i]] x C1[i][j])+C2[i][j]
Step 41: mcst=cst[i][j] and mpno[i]=j
Step 42: Increment j by 1
Step 43: Compute cst[i][j]=C0[i][j] x exp(-t[i][pno[i]] x C1[i][j])+C2[i][j]
Step 44: If (mcst <=cst[i][j])
mcst=mcst and mpno[i]=mpno[i]
Else
mcst=cst[i][j] and mpno[i]=j
Step 45: If (j<=nop[i])
Go to Step 42
Step 46: tcost[itr]= tcost[itr] + mcst
Step 47: If (pno[i]!=mpno[i])
k=k+1 and pno[i]=mpno[i]
Step 48: Increment i by 1

Step 49: If (i<=n)
Go to step 39
Step 50: If (k=0)
Go to step 51
Else
Go to step 17
Step 51: Display min(tcost[]) and its corresponding ta[][],pno[]

4. CASE STUDY

The wheel mounting assembly shown in Figure 2 is an example demonstrating the proposed methodology. The components of the complex assembly are manufactured with alternative processes. The bottom curve follower approach is used to determine the best alternative process for manufacturing the components and the LM method is used to allocate tolerance optimally to the components. The complex assembly consists of two interrelated dimensional chains, to which the component X2 is common. It is assumed that the cost model constants (C0, C1 and C2) of all the processes are available before starting the allocation process. The global optimum allocated tolerances are obtained using a Pentium IV personal computer and C programming language. The exhaustive LM search method is compared with the proposed method's results.

4.1 Wheel mounting assembly

The component and its dimension details of the wheel mounting assembly are shown in Figure 2. The exponential cost function constants of the part dimensions with alternative processes are listed in Table 1. The dimensions of Y1 and Y2 are computed from equations (8) and (9). The tolerance on dimension Y1 and Y2 are expressed in expressions (10) and (11).

$$Y1 = X2 - X4 \quad (8)$$

$$Y2 = X5 - X1 - X2 - X3 \quad (9)$$

$$t_{Y1} \leq 0.11 \geq t[X2][pno[X2]] + t[X4][pno[X4]] \quad (10)$$

$$t_{Y2} \leq 0.24 \geq t[X1][pno[X1]] + t[X2][pno[X2]] + t[X3][pno[X3]] + t[X5][pno[X5]] \quad (11)$$

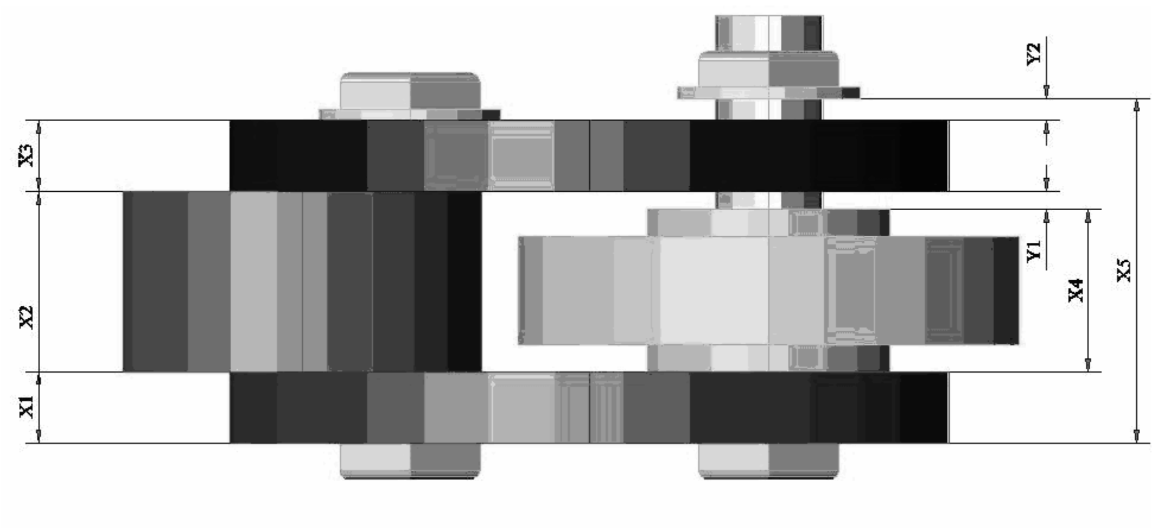

Figure 2: Wheel mounting assembly.

4.2 Numerical illustration - bottom curve follower approach

For demonstration purpose, the components X1, X2, X3, X4 and X5 are manufactured from process number 1,1,1,1 and 1 respectively. The cost function constants are listed in Table 2.

$$t_{asm1} = t[X1][1] + t[X2][1] + t[X3][1] + t[X5][1] \leq 0.24 \quad (12)$$

$$t_{asm2} = t[X2][1] + t[X4][1] \leq 0.11 \quad (13)$$

Part dimension (i)	Process number (j)	Cost model constants			Precision limits (mm)	
		C0[i][j]	C1[i][j]	C2[i][j]	t_{min}[i][j]	t_{max}[i][j]
X1,	1	241.00	55.80	28.20	0.006	0.080
X2	2	260.00	52.00	29.80	0.006	0.080
&	3	286.40	59.50	25.82	0.006	0.080
X3	4	271.50	57.64	23.00	0.006	0.080
X4	1	312.84	105.66	42.20	0.002	0.060
	2	352.43	92.70	35.00	0.002	0.060
X5	1	208.25	62.45	22.50	0.010	0.100
	2	240.43	66.70	20.20	0.010	0.100
	3	211.42	40.05	25.05	0.010	0.100
	4	214.16	58.82	300.00	0.010	0.100

Table 1: Exponential cost function constants of wheel mounting assembly (Singh et al.,).

*Note: All component's tolerance are in mm; the manufacturing cost is in $

Component (i)	Process No (j)	C0[i][j]	C1[i][j]	C2[i][j]	t_{min}[i][j]	t_{max}[i][j]
X1	1	241.00	55.80	28.2	0.006	0.08
X2	1	241.00	55.80	28.2	0.006	0.08
X3	1	241.00	55.80	28.2	0.006	0.08
X4	1	312.84	105.66	42.2	0.002	0.06
X5	1	208.25	62.45	22.5	0.010	0.10

Table 2: Cost function constant for initial calculation.

For simplification, the components are arranged in the order of X1, X3, X5, X2 &X4 instead of X1, X2, X3, X4 & X5.

Step 1: Initially, t_s is assumed as max(t_{min}[][]) i.e from the above table

t_s=max(t_{min}[][])=max(0.006,0.006,0.006,0.002,0.01)

t_s=0.01 and hence t[X1][1]=0.01.

For demonstration purpose, ts is assumed as 0.05

Step 2: Substitute the values of C0[][],C1[][] and C2[][] in the following expression in which the values are read from the Table 2.

$$t\ [X3][1] = \frac{\ln\left[\dfrac{C0[X3][1]\times C1[X3][1]\times \exp(C1[X1][1]\times t\ [X1][1])}{C0[X1][1]\times c1[X1][1]}\right]}{C1[X3][1]}$$

$$t\ [X3][1] = \frac{\ln\left[\dfrac{241\times 55.8\times \exp(55.8\times 0.05)}{241\times 55.8}\right]}{55.8} = 0.05$$

Step 3: It is necessary to check that the allocated tolerance t[X3][1] must lie between its process tolerance limits (t_{min}[X3][1] and t_{max}[X3][1]). In this case, it is true. If not, the t_s value is increased and the step 2 is again repeated.

$$t_{min}[X3][1] \le t[X3][1] \le t_{max}[X3][1]$$
$$0.006 \le 0.05 \le 0.08$$

Step 4: Similarly the value of t[X5][1] can be determined and checked as follows

$$t\ [X5][1] = \frac{\ln\left[\dfrac{208.25\times 62.45\times \exp(55.8\times 0.05)}{241\times 55.8}\right]}{62.45} = 0.04414$$
$$t_{min}[X5][1] \le t[X5][1] \le t_{max}[X5][1]$$
$$0.010 \le 0.04414 \le 0.10$$

Step 5: Similarly the value of t[X2][1] can be determined as follows

$$t\ [X2][1] = \frac{\ln\left[\dfrac{241\times 55.8\times \exp(62.45\times 0.04414)}{208.25\times 62.45}\right]}{55.8} = 0.05$$
$$t_{min}[X2][1] \le t[X2][1] \le t_{max}[X2][1]$$
$$0.006 \le 0.05 \le 0.08$$

Step 6: The value of assembly tolerance is determined from the expression (11) by substituting allocated tolerance of components X1, X2, X3 and X5.

t_{casm} =0.05 + 0.05 + 0.05 + 0.004414 = 0.19414

Step 7: The % difference between calculated and the required assembly tolerance is determined using the following equation

diff = 100x(t_{casm}-t_{asm1})/t_{casm}
= 100xabs(0.19414-0.24)/0.19414
diff = 23.62

Step 8: Since, the % difference is > 0.00001, the value of ts is incremented by 0.0001 and then the steps staring from 1 to 7 are carried out until the value of difference becomes <=0.00001.

Step 9: The optimum allocated tolerance of components after the above steps are t[X1][1]=0.061761;t[X2][1]=0.06176;t[X3][1]=0.061761;t[X5][1]=0.054649;

t_{casm1}=0.239932

The value of t[X4][1] is determined by substituting the value of t[X2][1] in the expression (12).

t_{asm2}=0.11= t[X2][1] + t[X4][1]

t[X4][1] = 0.11 – 0.06176 = 0.04824

Step 10: The manufacturing cost of the components are computed using the following expression.
The manufacturing cost of the component X1 will be

$$MC[X1][pno[X1]] = C0[X1][pno[X1]] \times \exp(-C1[X1][pno[X1]] \times t\ [X1][pno[X1]]) + C2[X1][pno[X1]]$$

$$MC[X1][1] = 241 \times \exp(-55.8 \times 0.061761) + 28.2 = 35.87934$$

Similarly, the manufacturing cost of the component X2, X3, X4 and X5 are

$$MC[X2][1] = 241 \times \exp(-55.8 \times 0.061761) + 28.2 = 35.87934$$

$$MC[X3][1] = 241 \times \exp(-55.8 \times 0.061761) + 28.2 = 35.87934$$

$$MC[X4][1] = 312.84 \times \exp(-105.66 \times 0.04824) + 42.2 = 44.11317$$

$$MC[X5][1] = 208.25 \times \exp(-62.45 \times 0.054649) + 22.5 = 29.36138$$

Step 11: Total cost of the product is determined using expression (3).

$$Cost_{asm} = \sum_{i=1}^{n} MC[i][1]$$

$$= 35.87934 + 35.87934 + 35.87934 + 44.11317 + 29.36138 = 181.1126$$

Step 12: The manufacturing cost of t[X1] []for other alternative process 2,3 and 4 are calculated as follows in which C0[][],C1[][] & C2[][] values are read from the table .

$$MC[X1][2] = 260 \times \exp(-52 \times 0.061761) + 29.8 = 40.27624$$

$$MC[X1][3] = 286.4 \times \exp(-59.5 \times 0.061761) + 25.82 = 33.08167$$

$$MC[X1][4] = 271.5 \times \exp(-57.64 \times 0.061761) + 23 = 30.72188$$

The minimum manufacturing cost of component X1 is obtained in process number 4. Hence, the component X1 is manufactured in process number 4 with the allocated tolerance value of 0.061761.

Step 13: The allocated tolerance of components X2 (t[X2][1]=0.061761) and X3 (t[X3][1]=0.061761) are same as X1, hence, the manufacturing processes are also same with X1. Hence, the components X2 and X3 are also manufactured in process number 4.

$$MC[X2][4] = 271.5 \times \exp(-57.64 \times 0.061761) + 23 = 30.72188$$

$$MC[X3][4] = 271.5 \times \exp(-57.64 \times 0.061761) + 23 = 30.72188$$

Step 14: In similar way, the manufacturing cost of component X4 is

$$MC[X4][2] = 352.43 \times \exp(-92.7 \times 0.04824) + 35 = 39.0273$$

Since, MC[X4][1] is more than the MC[X4][2], hence, the component X4 is manufactured in process number 2 with the allocated tolerance of 0.04824.

Step 15: The manufacturing cost of component X5 for different alternative processes 2,3 and 4 are

$$MC[X5][2] = 240.43 \times \exp(-66.7 \times 0.054649) + 20.2 = 26.47982$$

$$MC[X5][3] = 211.42 \times \exp(-40.05 \times 0.054649) + 25.05 = 48.7424$$

$$MC[X5][1] = 214.16 \times \exp(-58.82 \times 0.054649) + 300 = 308.6044$$

MC[X5][2] is less compared with other manufacturing cost MC[X5][1], MC[X5][3] and MC[X5][4], hence, the component X5 is manufactured in process number 2 with the allocated tolerance of 0.054649.

Step 16: The revised total cost of the product after implementation of bottom curve follower approach is

$$Cost_{asm} = MC[X1][4] + MC[X2][4] + MC[X3][4] + MC[X4][2] + MC[X5][2]$$

$$Cost_{asm} = 30.72188 + 30.72188 + 30.72188 + 39.0273 + 26.47982 = 157.6728$$

Step 17: Now, the process number of components X1, X2, X3, X4 and X5 is assumed as 4,4,4,2 and 2. The step 1 to step 15 are repeated again and again, when there is no change in the process number of the components.

For all combinations of processes (exhaustive search), the above steps are executed. The results are presented in Table B.1 (Appendix B), in which the allocated tolerances are shown in four-decimal accuracy and the tolerance cost is shown in single-decimal accuracy for the sake of simplicity. However, the actual calculation was carried out up to six-decimal accuracy. The process number based on the bottom curve follower approach for the components/dimensions X1, X2, X3, X4 and X5 are 4, 4, 4, 2 and 2 respectively.

5. RESULTS

The allocated tolerance and its manufacturing cost based on the LM method using the bottom curve follower method (proposed method) and Singh's [14] method for wheel mounting assembly are presented in Table 3. The percentage deviation of manufacturing cost for the wheel mounting assembly between Singh's method and the proposed method is estimated as,

$$Deviation = \frac{(159.998 - 156.875) \times 100}{159.998} = 1.95\%$$

	Singh Method			Bottom Curve Follower Approach		
Part Dimension	**Process No.**	**Tolerance (mm)**	**Cost ($)**	**Process No.**	**Tolerance (mm)**	**Cost ($)**
X1	4	0.0633	30.0664	4	0.06322	30.09864
X2	4	0.055	34.4017	4	0.05882	32.14838
X3	4	0.0612	30.9757	4	0.06322	30.09864
X4	2	0.0546	37.2332	2	0.05118	38.06628
X5	1	0.0603	27.3211	2	0.05469	26.46350
t_{Y1}		0.2398			0.23995	
t_{Y2}		0.1096			0.11	
Total Cost			159.9981			156.87545

Table 3: Comparison between Singh [14] and the proposed method.

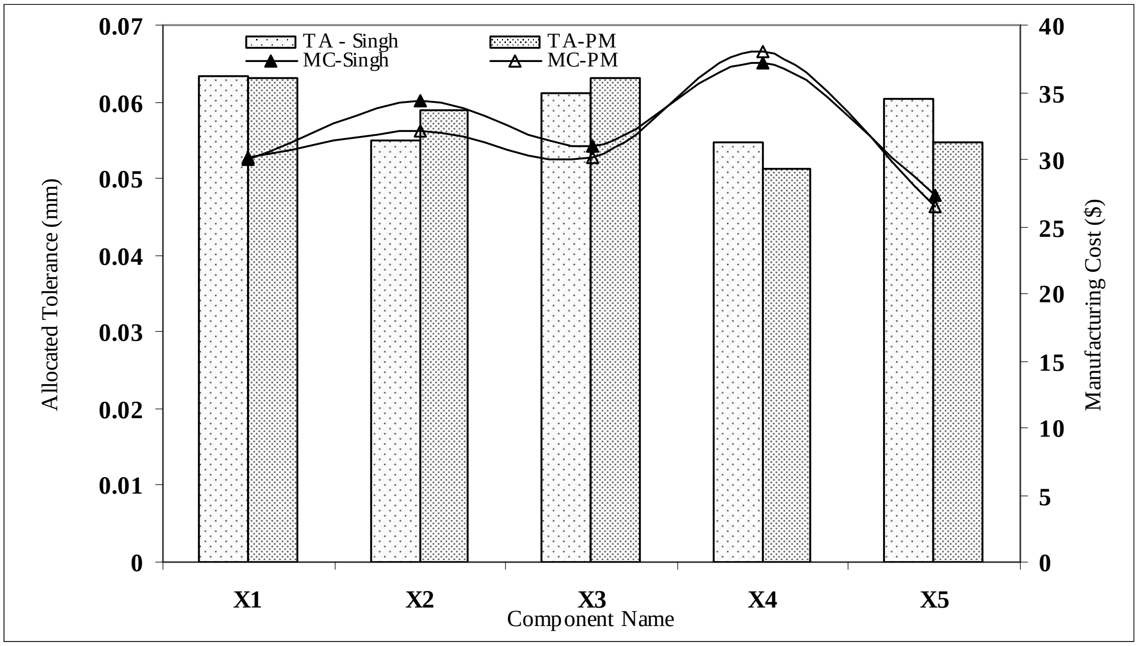

FIGURE 3: Optimum allocated tolerance and manufacturing cost comparison
TA- Optimum allocated tolerance; MC – Manufacturing cost; PM – Proposed method

6. CONCLUSION

Tolerance distribution among the components of an assembly affects manufacturing costs. The solutions obtained using nontraditional optimization techniques were not consistent and were randomly generated for each trial/run. There was also the possibility of omit the best process for optimum tolerance allocation. An attempt was made in this work to obtain the optimum allocated tolerance for interrelated dimensional chains products using the LM method with the bottom curve follower approach. The results of the exhaustive search method and the proposed method were compared. It was interesting to note that the proposed method yielded better results than both the exhaustive search method and Singh's [14] method. Once implemented in complex assembly, the proposed method resulted in 1.95% savings in the manufacturing cost of a product compared to Singh's method. The computation time in terms of CPU time is compared with the existing method in Table 4. It is understood from the Table 4 that the proposed method is approximately 30 times faster than the existing method in allocating tolerance optimally to the components of a complex assembly.

Method	Process combinations	CPU Time (sec)
Singh [14]	44421	5.37
Siva Kumar [19]	44422	5.26
Proposed method	44421	0.18

Table 4: CPU Time for the proposed method.

Appendix - A

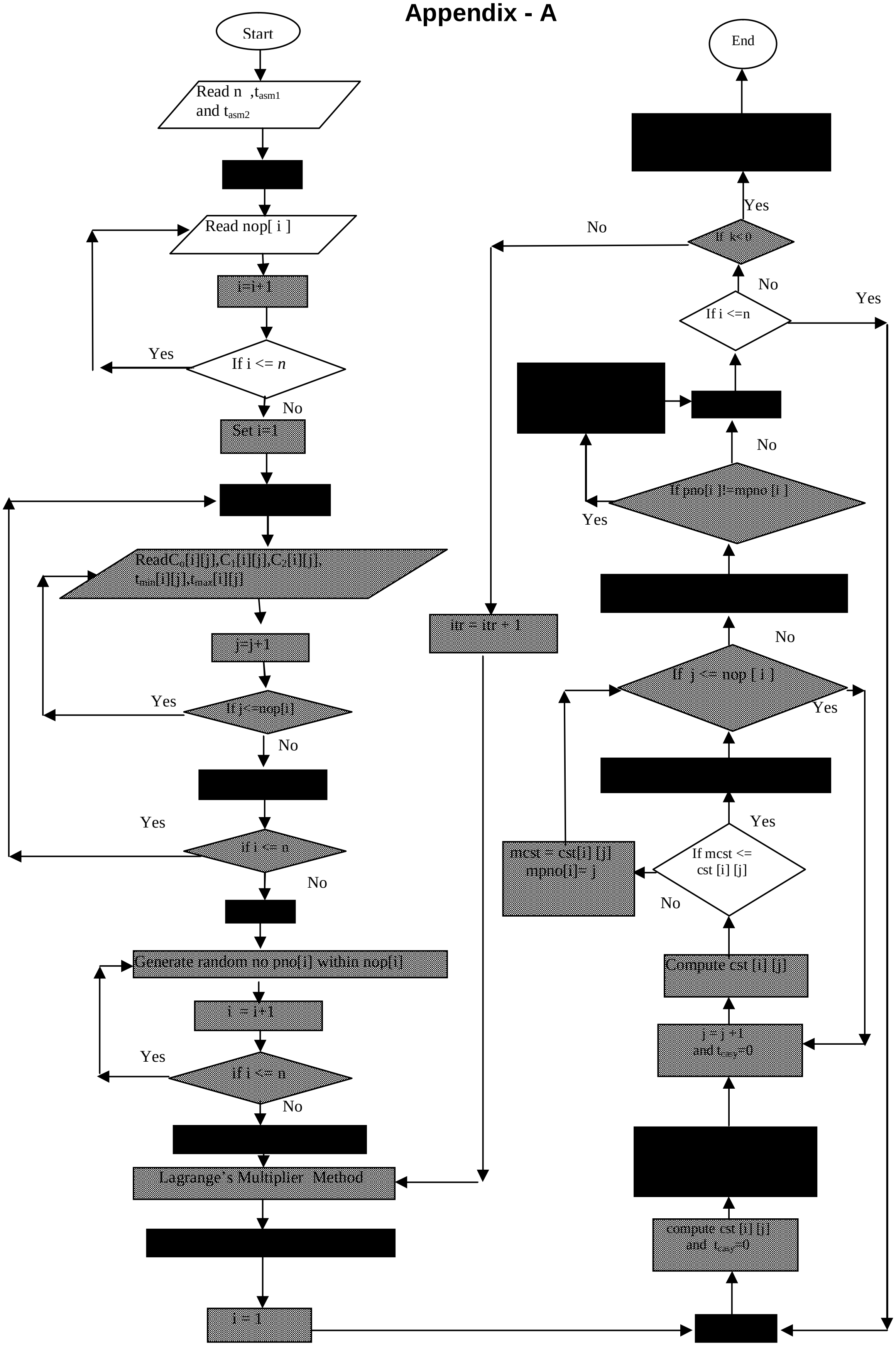

FIGURE A: 1 Flow chart of bottom curve follower approach.

A. 1 Lagrange's multiplier method for worst-case criteria

$$\frac{\partial}{\partial T_i}[mc\_fun] + \lambda \frac{\partial}{\partial t_i}[asy\_cont] = 0 \tag{A.1}$$

$$mc\_fun = C0 \times \exp(-C1 \times t) + C2 \tag{A.2}$$

$$asy\_cont = t - t_{asm} \tag{A.3}$$

After substitution of equations (A.2) and (A.3) in equation (A.1), we get

$$\frac{\partial}{\partial t_i}[C0 \times \exp(-C1 \times t) + C2] + \lambda \frac{\partial}{\partial t_i}[t - t_{asm}] = 0$$

$$-C0 \times C1 \times \exp(-C1 \times t) + \lambda = 0$$

$$\lambda = \frac{C0 \times C1}{\exp(C1 \times t)} = \frac{C0_1 \times C1_1}{\exp(C1_1 \times t_1)} = \frac{C0_2 \times C1_2}{\exp(C1_2 \times t_2)} \tag{A.4}$$

$$t_2 = \frac{\ln\left[\dfrac{C0_2 \times C1_2 \times \exp(C1_1 \times t_1)}{C0_1 \times C1_1}\right]}{C1_2} \tag{A.5}$$

General representation of equation (A.5) is

$$t_{i+1} = \frac{\ln\left[\dfrac{C0_{i+1} \times C1_{i+1} \times \exp(C1_i \times t_i)}{C0_i \times C1_i}\right]}{C1_{i+1}} \tag{A.6}$$

Appendix – B

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
11111	0.0618	35.9	30.7	0.0618	35.9	30.7	0.0618	35.9	30.7	0.0482	44.1	39.0	0.0546	29.4	26.5	181.1	157.7	0.24	0.11
11112	0.0618	35.9	30.7	0.0618	35.9	30.7	0.0618	35.9	30.7	0.0482	39.0	39.0	0.0546	29.4	26.5	176.0	157.7	0.24	0.11
11121	0.0619	35.8	30.7	0.0619	35.8	30.7	0.0619	35.8	30.7	0.0481	44.1	39.1	0.0544	26.6	26.6	178.2	157.7	0.24	0.11
11122	0.0619	35.8	30.7	0.0619	35.8	30.7	0.0619	35.8	30.7	0.0481	39.1	39.1	0.0544	26.6	26.6	173.2	157.7	0.24	0.11
11131	0.0572	38.1	33.0	0.0572	38.1	33.0	0.0572	38.1	33.0	0.0528	43.4	37.6	0.0682	38.8	22.7	196.5	159.5	0.24	0.11
11132	0.0572	38.1	33.0	0.0572	38.1	33.0	0.0572	38.1	33.0	0.0528	37.6	37.6	0.0682	38.8	22.7	190.7	159.5	0.24	0.11
11141	0.0611	36.2	31.0	0.0611	36.2	31.0	0.0611	36.2	31.0	0.0489	44.0	38.8	0.0568	307.6	25.6	460.1	157.5	0.24	0.11
11142	0.0611	36.2	31.0	0.0611	36.2	31.0	0.0611	36.2	31.0	0.0489	38.8	38.8	0.0568	307.6	25.6	454.9	157.5	0.24	0.11
11211	0.0606	36.4	31.3	0.0606	36.4	31.3	0.0651	38.6	29.4	0.0494	43.9	38.6	0.0536	29.8	26.9	185.1	157.4	0.24	0.11
11212	0.0606	36.4	31.3	0.0606	36.4	31.3	0.0651	38.6	29.4	0.0494	38.6	38.6	0.0536	29.8	26.9	179.8	157.4	0.24	0.11
11221	0.0607	36.4	31.2	0.0607	36.4	31.2	0.0652	38.6	29.3	0.0493	43.9	38.6	0.0534	27.0	27.0	182.2	157.4	0.24	0.11
11222	0.0607	36.4	31.2	0.0607	36.4	31.2	0.0652	38.6	29.3	0.0493	38.6	38.6	0.0534	27.0	27.0	176.9	157.4	0.24	0.11
11231	0.0563	38.6	33.6	0.0563	38.6	33.6	0.0605	41.0	31.3	0.0537	43.3	37.4	0.0669	39.6	23.0	201.1	158.9	0.24	0.11
11232	0.0563	38.6	33.6	0.0563	38.6	33.6	0.0605	41.0	31.3	0.0537	37.4	37.4	0.0669	39.6	23.0	195.2	158.9	0.24	0.11
11241	0.0599	36.7	31.6	0.0599	36.7	31.6	0.0644	38.9	29.6	0.0501	43.8	38.4	0.0557	308.1	26.0	464.2	157.2	0.24	0.11
11242	0.0599	36.7	31.6	0.0599	36.7	31.6	0.0644	38.9	29.6	0.0501	38.4	38.4	0.0557	308.1	26.0	458.8	157.2	0.24	0.11
11311	0.0617	35.9	30.7	0.0617	35.9	30.7	0.0619	33.0	30.7	0.0483	44.1	39.0	0.0546	29.4	26.5	178.3	157.6	0.24	0.11
11312	0.0617	35.9	30.7	0.0617	35.9	30.7	0.0619	33.0	30.7	0.0483	39.0	39.0	0.0546	29.4	26.5	173.2	157.6	0.24	0.11
11321	0.0618	35.9	30.7	0.0618	35.9	30.7	0.0620	33.0	30.6	0.0482	44.1	39.0	0.0544	26.6	26.6	175.4	157.7	0.24	0.11
11322	0.0618	35.9	30.7	0.0618	35.9	30.7	0.0620	33.0	30.6	0.0482	39.0	39.0	0.0544	26.6	26.6	170.4	157.7	0.24	0.11
11331	0.0572	38.1	33.1	0.0572	38.1	33.1	0.0576	35.1	32.8	0.0528	43.4	37.6	0.0681	38.9	22.8	193.6	159.3	0.24	0.11
11332	0.0572	38.1	33.1	0.0572	38.1	33.1	0.0576	35.1	32.8	0.0528	37.6	37.6	0.0681	38.9	22.8	187.9	159.3	0.24	0.11
11341	0.0610	36.2	31.1	0.0610	36.2	31.1	0.0612	33.3	31.0	0.0490	44.0	38.8	0.0568	307.6	25.7	457.3	157.5	0.24	0.11
11342	0.0610	36.2	31.1	0.0610	36.2	31.1	0.0612	33.3	31.0	0.0490	38.8	38.8	0.0568	307.6	25.7	452.1	157.5	0.24	0.11
11411	0.0616	35.9	30.8	0.0616	35.9	30.8	0.0623	30.5	30.5	0.0484	44.1	39.0	0.0545	29.4	26.5	175.9	157.6	0.24	0.11
11412	0.0616	35.9	30.8	0.0616	35.9	30.8	0.0623	30.5	30.5	0.0484	39.0	39.0	0.0545	29.4	26.5	170.8	157.6	0.24	0.11
11421	0.0617	35.9	30.8	0.0617	35.9	30.8	0.0623	30.5	30.5	0.0483	44.1	39.0	0.0542	26.7	26.7	173.0	157.6	0.24	0.11
11422	0.0617	35.9	30.8	0.0617	35.9	30.8	0.0623	30.5	30.5	0.0483	39.0	39.0	0.0542	26.7	26.7	167.9	157.6	0.24	0.11
11431	0.0571	38.2	33.1	0.0571	38.2	33.1	0.0579	32.7	32.7	0.0529	43.4	37.6	0.0680	39.0	22.8	191.3	159.3	0.24	0.11
11432	0.0571	38.2	33.1	0.0571	38.2	33.1	0.0579	32.7	32.7	0.0529	37.6	37.6	0.0680	39.0	22.8	185.6	159.3	0.24	0.11
11441	0.0609	36.3	31.1	0.0609	36.3	31.1	0.0616	30.8	30.8	0.0491	43.9	38.7	0.0566	307.7	25.7	454.9	157.5	0.24	0.11
11442	0.0609	36.3	31.1	0.0609	36.3	31.1	0.0616	30.8	30.8	0.0491	38.7	38.7	0.0566	307.7	25.7	449.7	157.5	0.24	0.11
12111	0.0606	36.4	31.3	0.0651	38.6	29.4	0.0606	36.4	31.3	0.0449	44.9	40.5	0.0536	29.8	26.9	186.1	159.3	0.24	0.11
12112	0.0606	36.4	31.3	0.0651	38.6	29.4	0.0606	36.4	31.3	0.0449	40.5	40.5	0.0536	29.8	26.9	181.7	159.3	0.24	0.11
12121	0.0607	36.4	31.2	0.0652	38.6	29.3	0.0607	36.4	31.2	0.0448	45.0	40.5	0.0534	27.0	27.0	183.2	159.3	0.24	0.11
12122	0.0607	36.4	31.2	0.0652	38.6	29.3	0.0607	36.4	31.2	0.0448	40.5	40.5	0.0534	27.0	27.0	178.8	159.3	0.24	0.11
12131	0.0563	38.6	33.6	0.0605	41.0	31.3	0.0563	38.6	33.6	0.0495	43.9	38.6	0.0669	39.6	23.0	201.7	160.0	0.24	0.11
12132	0.0563	38.6	33.6	0.0605	41.0	31.3	0.0563	38.6	33.6	0.0495	38.6	38.6	0.0669	39.6	23.0	196.4	160.0	0.24	0.11
12141	0.0599	36.7	31.6	0.0644	38.9	29.6	0.0599	36.7	31.6	0.0456	44.7	40.1	0.0557	308.1	26.0	465.2	159.0	0.24	0.11
12142	0.0599	36.7	31.6	0.0644	38.9	29.6	0.0599	36.7	31.6	0.0456	40.1	40.1	0.0557	308.1	26.0	460.6	159.0	0.24	0.11
12211	0.0595	36.9	31.8	0.0639	39.2	29.8	0.0639	39.2	29.8	0.0461	44.6	39.9	0.0526	30.3	27.4	190.1	158.8	0.24	0.11
12212	0.0595	36.9	31.8	0.0639	39.2	29.8	0.0639	39.2	29.8	0.0461	39.9	39.9	0.0526	30.3	27.4	185.5	158.8	0.24	0.11
12221	0.0595	36.9	31.8	0.0640	39.1	29.8	0.0640	39.1	29.8	0.0460	44.6	40.0	0.0525	27.5	27.5	187.2	158.8	0.24	0.11
12222	0.0595	36.9	31.8	0.0640	39.1	29.8	0.0640	39.1	29.8	0.0460	40.0	40.0	0.0525	27.5	27.5	182.6	158.8	0.24	0.11
12231	0.0554	39.2	34.2	0.0595	41.6	31.8	0.0595	41.6	31.8	0.0505	43.7	38.3	0.0656	40.3	23.2	206.4	159.2	0.24	0.11
12232	0.0554	39.2	34.2	0.0595	41.6	31.8	0.0595	41.6	31.8	0.0505	38.3	38.3	0.0656	40.3	23.2	200.9	159.2	0.24	0.11
12241	0.0588	37.2	32.1	0.0632	39.5	30.1	0.0632	39.5	30.1	0.0468	44.4	39.6	0.0547	308.6	26.5	469.3	158.4	0.24	0.11
12242	0.0588	37.2	32.1	0.0632	39.5	30.1	0.0632	39.5	30.1	0.0468	39.6	39.6	0.0547	308.6	26.5	464.5	158.4	0.24	0.11
12311	0.0605	36.4	31.3	0.0651	38.6	29.4	0.0608	33.5	31.2	0.0449	44.9	40.5	0.0536	29.8	27.0	183.3	159.3	0.24	0.11
12312	0.0605	36.4	31.3	0.0651	38.6	29.4	0.0608	33.5	31.2	0.0449	40.5	40.5	0.0536	29.8	27.0	178.9	159.3	0.24	0.11
12321	0.0606	36.4	31.2	0.0652	38.6	29.4	0.0608	33.5	31.1	0.0448	44.9	40.5	0.0534	27.0	27.0	180.4	159.3	0.24	0.11
12322	0.0606	36.4	31.2	0.0652	38.6	29.4	0.0608	33.5	31.1	0.0448	40.5	40.5	0.0534	27.0	27.0	176.0	159.3	0.24	0.11
12331	0.0562	38.7	33.7	0.0604	41.1	31.4	0.0567	35.7	33.4	0.0496	43.9	38.5	0.0667	39.7	23.0	198.9	159.9	0.24	0.11
12332	0.0562	38.7	33.7	0.0604	41.1	31.4	0.0567	35.7	33.4	0.0496	38.5	38.5	0.0667	39.7	23.0	193.6	159.9	0.24	0.11
12341	0.0599	36.7	31.6	0.0643	39.0	29.7	0.0601	33.8	31.5	0.0457	44.7	40.1	0.0557	308.1	26.1	462.3	158.9	0.24	0.11
12342	0.0599	36.7	31.6	0.0643	39.0	29.7	0.0601	33.8	31.5	0.0457	40.1	40.1	0.0557	308.1	26.1	457.7	158.9	0.24	0.11
12411	0.0604	36.5	31.3	0.0649	38.7	29.4	0.0611	31.0	31.0	0.0451	44.9	40.4	0.0535	29.9	27.0	180.9	159.2	0.24	0.11
12412	0.0604	36.5	31.3	0.0649	38.7	29.4	0.0611	31.0	31.0	0.0451	40.4	40.4	0.0535	29.9	27.0	176.5	159.2	0.24	0.11
12421	0.0605	36.4	31.3	0.0650	38.6	29.4	0.0612	31.0	31.0	0.0450	44.9	40.5	0.0533	27.1	27.1	178.0	159.2	0.24	0.11
12422	0.0605	36.4	31.3	0.0650	38.6	29.4	0.0612	31.0	31.0	0.0450	40.5	40.5	0.0533	27.1	27.1	173.6	159.2	0.24	0.11
12431	0.0561	38.7	33.7	0.0603	41.1	31.4	0.0569	33.2	33.2	0.0497	43.8	38.5	0.0666	39.7	23.0	196.6	159.8	0.24	0.11
12432	0.0561	38.7	33.7	0.0603	41.1	31.4	0.0569	33.2	33.2	0.0497	38.5	38.5	0.0666	39.7	23.0	191.3	159.8	0.24	0.11
12441	0.0597	36.8	31.7	0.0642	39.0	29.7	0.0605	31.3	31.3	0.0458	44.7	40.1	0.0556	308.2	26.1	460.0	158.9	0.24	0.11
12442	0.0597	36.8	31.7	0.0642	39.0	29.7	0.0605	31.3	31.3	0.0458	40.1	40.1	0.0556	308.2	26.1	455.3	158.9	0.24	0.11
13111	0.0617	35.9	30.7	0.0619	33.0	30.7	0.0617	35.9	30.7	0.0481	44.1	39.1	0.0546	29.4	26.5	178.3	157.7	0.24	0.11
13112	0.0617	35.9	30.7	0.0619	33.0	30.7	0.0617	35.9	30.7	0.0481	39.1	39.1	0.0546	29.4	26.5	173.2	157.7	0.24	0.11
13121	0.0618	35.9	30.7	0.0620	33.0	30.6	0.0618	35.9	30.7	0.0480	44.2	39.1	0.0544	26.6	26.6	175.5	157.7	0.24	0.11
13122	0.0618	35.9	30.7	0.0620	33.0	30.6	0.0618	35.9	30.7	0.0480	39.1	39.1	0.0544	26.6	26.6	170.4	157.7	0.24	0.11
13131	0.0572	38.1	33.1	0.0576	35.1	32.8	0.0572	38.1	33.1	0.0524	43.4	37.7	0.0681	38.9	22.8	193.7	159.5	0.24	0.11
13132	0.0572	38.1	33.1	0.0576	35.1	32.8	0.0572	38.1	33.1	0.0524	37.7	37.7	0.0681	38.9	22.8	188.0	159.5	0.24	0.11
13141	0.0610	36.2	31.1	0.0612	33.3	31.0	0.0610	36.2	31.1	0.0488	44.0	38.8	0.0568	307.6	25.7	457.4	157.6	0.24	0.11

13142	0.0610	36.2	31.1	0.0612	33.3	31.0	0.0610	36.2	31.1	0.0488	38.8	38.8	0.0568	307.6	25.7	452.2	157.6	0.24	0.11
13211	0.0605	36.4	31.3	0.0608	33.5	31.2	0.0651	38.6	29.4	0.0492	43.9	38.7	0.0536	29.8	27.0	182.3	157.5	0.24	0.11
13212	0.0605	36.4	31.3	0.0608	33.5	31.2	0.0651	38.6	29.4	0.0492	38.7	38.7	0.0536	29.8	27.0	177.1	157.5	0.24	0.11
13221	0.0606	36.4	31.2	0.0608	33.5	31.1	0.0652	38.6	29.4	0.0492	43.9	38.7	0.0534	27.0	27.0	179.4	157.5	0.24	0.11
13222	0.0606	36.4	31.2	0.0608	33.5	31.1	0.0652	38.6	29.4	0.0492	38.7	38.7	0.0534	27.0	27.0	174.2	157.5	0.24	0.11
13231	0.0562	38.7	33.7	0.0567	35.7	33.4	0.0604	41.1	31.4	0.0533	43.3	37.5	0.0667	39.7	23.0	198.4	158.9	0.24	0.11
13232	0.0562	38.7	33.7	0.0567	35.7	33.4	0.0604	41.1	31.4	0.0533	37.5	37.5	0.0667	39.7	23.0	192.6	158.9	0.24	0.11
13241	0.0599	36.7	31.6	0.0601	33.8	31.5	0.0643	39.0	29.7	0.0499	43.8	38.5	0.0557	308.1	26.1	461.4	157.3	0.24	0.11
13242	0.0599	36.7	31.6	0.0601	33.8	31.5	0.0643	39.0	29.7	0.0499	38.5	38.5	0.0557	308.1	26.1	456.1	157.3	0.24	0.11
13311	0.0617	35.9	30.7	0.0618	33.0	30.7	0.0618	33.0	30.7	0.0482	44.1	39.1	0.0546	29.4	26.5	175.5	157.7	0.24	0.11
13312	0.0617	35.9	30.7	0.0618	33.0	30.7	0.0618	33.0	30.7	0.0482	39.1	39.1	0.0546	29.4	26.5	170.4	157.7	0.24	0.11
13321	0.0618	35.9	30.7	0.0619	33.0	30.7	0.0619	33.0	30.7	0.0481	44.1	39.1	0.0543	26.6	26.6	172.7	157.7	0.24	0.11
13322	0.0618	35.9	30.7	0.0619	33.0	30.7	0.0619	33.0	30.7	0.0481	39.1	39.1	0.0543	26.6	26.6	167.6	157.7	0.24	0.11
13331	0.0571	38.2	33.1	0.0575	35.2	32.9	0.0575	35.2	32.9	0.0525	43.4	37.7	0.0680	39.0	22.8	190.9	159.4	0.24	0.11
13332	0.0571	38.2	33.1	0.0575	35.2	32.9	0.0575	35.2	32.9	0.0525	37.7	37.7	0.0680	39.0	22.8	185.2	159.4	0.24	0.11
13341	0.0610	36.2	31.1	0.0612	33.4	31.0	0.0612	33.4	31.0	0.0489	44.0	38.8	0.0567	307.6	25.7	454.5	157.6	0.24	0.11
13342	0.0610	36.2	31.1	0.0612	33.4	31.0	0.0612	33.4	31.0	0.0489	38.8	38.8	0.0567	307.6	25.7	449.4	157.6	0.24	0.11
13411	0.0616	36.0	30.8	0.0617	33.1	30.7	0.0622	30.5	30.5	0.0483	44.1	39.0	0.0545	29.4	26.6	173.1	157.6	0.24	0.11
13412	0.0616	36.0	30.8	0.0617	33.1	30.7	0.0622	30.5	30.5	0.0483	39.0	39.0	0.0545	29.4	26.6	168.0	157.6	0.24	0.11
13421	0.0616	35.9	30.8	0.0618	33.1	30.7	0.0623	30.5	30.5	0.0482	44.1	39.0	0.0542	26.7	26.7	170.3	157.7	0.24	0.11
13422	0.0616	35.9	30.8	0.0618	33.1	30.7	0.0623	30.5	30.5	0.0482	39.0	39.0	0.0542	26.7	26.7	165.2	157.7	0.24	0.11
13431	0.0570	38.2	33.2	0.0574	35.2	32.9	0.0578	32.7	32.7	0.0526	43.4	37.7	0.0678	39.0	22.8	188.6	159.3	0.24	0.11
13432	0.0570	38.2	33.2	0.0574	35.2	32.9	0.0578	32.7	32.7	0.0526	37.7	37.7	0.0678	39.0	22.8	182.9	159.3	0.24	0.11
13441	0.0608	36.3	31.2	0.0610	33.4	31.1	0.0615	30.8	30.8	0.0490	44.0	38.8	0.0566	307.7	25.7	452.2	157.5	0.24	0.11
13442	0.0608	36.3	31.2	0.0610	33.4	31.1	0.0615	30.8	30.8	0.0490	38.8	38.8	0.0566	307.7	25.7	447.0	157.5	0.24	0.11
14111	0.0616	35.9	30.8	0.0623	30.5	30.5	0.0616	35.9	30.8	0.0477	44.2	39.2	0.0545	29.4	26.5	176.0	157.8	0.24	0.11
14112	0.0616	35.9	30.8	0.0623	30.5	30.5	0.0616	35.9	30.8	0.0477	39.2	39.2	0.0545	29.4	26.5	171.0	157.8	0.24	0.11
14121	0.0617	35.9	30.8	0.0623	30.5	30.5	0.0617	35.9	30.8	0.0477	44.2	39.3	0.0542	26.7	26.7	173.2	157.9	0.24	0.11
14122	0.0617	35.9	30.8	0.0623	30.5	30.5	0.0617	35.9	30.8	0.0477	39.3	39.3	0.0542	26.7	26.7	168.2	157.9	0.24	0.11
14131	0.0571	38.2	33.1	0.0579	32.7	32.7	0.0571	38.2	33.1	0.0521	43.5	37.8	0.0680	39.0	22.8	191.5	159.5	0.24	0.11
14132	0.0571	38.2	33.1	0.0579	32.7	32.7	0.0571	38.2	33.1	0.0521	37.8	37.8	0.0680	39.0	22.8	185.8	159.5	0.24	0.11
14141	0.0609	36.3	31.1	0.0616	30.8	30.8	0.0609	36.3	31.1	0.0484	44.1	39.0	0.0566	307.7	25.7	455.1	157.7	0.24	0.11
14142	0.0609	36.3	31.1	0.0616	30.8	30.8	0.0609	36.3	31.1	0.0484	39.0	39.0	0.0566	307.7	25.7	449.9	157.7	0.24	0.11
14211	0.0604	36.5	31.3	0.0611	31.0	31.0	0.0649	38.7	29.4	0.0489	44.0	38.8	0.0535	29.9	27.0	180.0	157.6	0.24	0.11
14212	0.0604	36.5	31.3	0.0611	31.0	31.0	0.0649	38.7	29.4	0.0489	38.8	38.8	0.0535	29.9	27.0	174.9	157.6	0.24	0.11
14221	0.0605	36.4	31.3	0.0612	31.0	31.0	0.0650	38.6	29.4	0.0488	44.0	38.8	0.0533	27.1	27.1	177.2	157.6	0.24	0.11
14222	0.0605	36.4	31.3	0.0612	31.0	31.0	0.0650	38.6	29.4	0.0488	38.8	38.8	0.0533	27.1	27.1	172.0	157.6	0.24	0.11
14231	0.0561	38.7	33.7	0.0569	33.2	33.2	0.0603	41.1	31.4	0.0531	43.3	37.6	0.0666	39.7	23.0	196.1	158.9	0.24	0.11
14232	0.0561	38.7	33.7	0.0569	33.2	33.2	0.0603	41.1	31.4	0.0531	37.6	37.6	0.0666	39.7	23.0	190.3	158.9	0.24	0.11
14241	0.0597	36.8	31.7	0.0605	31.3	31.3	0.0642	39.0	29.7	0.0495	43.9	38.6	0.0556	308.2	26.1	459.2	157.4	0.24	0.11
14242	0.0597	36.8	31.7	0.0605	31.3	31.3	0.0642	39.0	29.7	0.0495	38.6	38.6	0.0556	308.2	26.1	453.9	157.4	0.24	0.11
14311	0.0616	36.0	30.8	0.0622	30.5	30.5	0.0617	33.1	30.7	0.0478	44.2	39.2	0.0545	29.4	26.6	173.2	157.8	0.24	0.11
14312	0.0616	36.0	30.8	0.0622	30.5	30.5	0.0617	33.1	30.7	0.0478	39.2	39.2	0.0545	29.4	26.6	168.2	157.8	0.24	0.11
14321	0.0616	35.9	30.8	0.0623	30.5	30.5	0.0618	33.1	30.7	0.0477	44.2	39.2	0.0542	26.7	26.7	170.4	157.9	0.24	0.11
14322	0.0616	35.9	30.8	0.0623	30.5	30.5	0.0618	33.1	30.7	0.0477	39.2	39.2	0.0542	26.7	26.7	165.4	157.9	0.24	0.11
14331	0.0570	38.2	33.2	0.0578	32.7	32.7	0.0574	35.2	32.9	0.0522	43.5	37.8	0.0678	39.0	22.8	188.7	159.4	0.24	0.11
14332	0.0570	38.2	33.2	0.0578	32.7	32.7	0.0574	35.2	32.9	0.0522	37.8	37.8	0.0678	39.0	22.8	183.0	159.4	0.24	0.11
14341	0.0608	36.3	31.2	0.0615	30.8	30.8	0.0610	33.4	31.1	0.0485	44.1	38.9	0.0566	307.7	25.7	452.3	157.7	0.24	0.11
14342	0.0608	36.3	31.2	0.0615	30.8	30.8	0.0610	33.4	31.1	0.0485	38.9	38.9	0.0566	307.7	25.7	447.1	157.7	0.24	0.11
14411	0.0614	36.0	30.9	0.0621	30.6	30.6	0.0621	30.6	30.6	0.0479	44.2	39.2	0.0543	29.5	26.6	170.9	157.8	0.24	0.11
14412	0.0614	36.0	30.9	0.0621	30.6	30.6	0.0621	30.6	30.6	0.0479	39.2	39.2	0.0543	29.5	26.6	165.8	157.8	0.24	0.11
14421	0.0615	36.0	30.8	0.0622	30.5	30.5	0.0622	30.5	30.5	0.0478	44.2	39.2	0.0541	26.7	26.7	168.0	157.8	0.24	0.11
14422	0.0615	36.0	30.8	0.0622	30.5	30.5	0.0622	30.5	30.5	0.0478	39.2	39.2	0.0541	26.7	26.7	163.0	157.8	0.24	0.11
14431	0.0569	38.3	33.2	0.0577	32.8	32.8	0.0577	32.8	32.8	0.0523	43.4	37.8	0.0677	39.1	22.8	186.3	159.3	0.24	0.11
14432	0.0569	38.3	33.2	0.0577	32.8	32.8	0.0577	32.8	32.8	0.0523	37.8	37.8	0.0677	39.1	22.8	180.7	159.3	0.24	0.11
14441	0.0607	36.3	31.2	0.0614	30.9	30.9	0.0614	30.9	30.9	0.0486	44.0	38.9	0.0565	307.7	25.8	449.9	157.6	0.24	0.11
14442	0.0607	36.3	31.2	0.0614	30.9	30.9	0.0614	30.9	30.9	0.0486	38.9	38.9	0.0565	307.7	25.8	444.7	157.6	0.24	0.11
21111	0.0651	38.6	29.4	0.0606	36.4	31.3	0.0606	36.4	31.3	0.0494	43.9	38.6	0.0536	29.8	26.9	185.1	157.4	0.24	0.11
21112	0.0651	38.6	29.4	0.0606	36.4	31.3	0.0606	36.4	31.3	0.0494	38.6	38.6	0.0536	29.8	26.9	179.8	157.4	0.24	0.11
21121	0.0652	38.6	29.3	0.0607	36.4	31.2	0.0607	36.4	31.2	0.0493	43.9	38.6	0.0534	27.0	27.0	182.2	157.4	0.24	0.11
21122	0.0652	38.6	29.3	0.0607	36.4	31.2	0.0607	36.4	31.2	0.0493	38.6	38.6	0.0534	27.0	27.0	176.9	157.4	0.24	0.11
21131	0.0605	41.0	31.3	0.0563	38.6	33.6	0.0563	38.6	33.6	0.0537	43.3	37.4	0.0669	39.6	23.0	201.1	158.9	0.24	0.11
21132	0.0605	41.0	31.3	0.0563	38.6	33.6	0.0563	38.6	33.6	0.0537	37.4	37.4	0.0669	39.6	23.0	195.2	158.9	0.24	0.11
21141	0.0644	38.9	29.6	0.0599	36.7	31.6	0.0599	36.7	31.6	0.0501	43.8	38.4	0.0557	308.1	26.0	464.2	157.2	0.24	0.11
21142	0.0644	38.9	29.6	0.0599	36.7	31.6	0.0599	36.7	31.6	0.0501	38.4	38.4	0.0557	308.1	26.0	458.8	157.2	0.24	0.11
21211	0.0639	39.2	29.8	0.0595	36.9	31.8	0.0639	39.2	29.8	0.0505	43.7	38.3	0.0526	30.3	27.4	189.2	157.1	0.24	0.11
21212	0.0639	39.2	29.8	0.0595	36.9	31.8	0.0639	39.2	29.8	0.0505	38.3	38.3	0.0526	30.3	27.4	183.8	157.1	0.24	0.11
21221	0.0640	39.1	29.8	0.0595	36.9	31.8	0.0640	39.1	29.8	0.0505	43.7	38.3	0.0524	27.5	27.5	186.4	157.1	0.24	0.11
21222	0.0640	39.1	29.8	0.0595	36.9	31.8	0.0640	39.1	29.8	0.0505	38.3	38.3	0.0524	27.5	27.5	180.9	157.1	0.24	0.11
21231	0.0595	41.6	31.8	0.0554	39.2	34.2	0.0595	41.6	31.8	0.0546	43.2	37.2	0.0656	40.3	23.2	205.9	158.2	0.24	0.11
21232	0.0595	41.6	31.8	0.0554	39.2	34.2	0.0595	41.6	31.8	0.0546	37.2	37.2	0.0656	40.3	23.2	199.9	158.2	0.24	0.11
21241	0.0632	39.5	30.1	0.0588	37.2	32.1	0.0632	39.5	30.1	0.0512	43.6	38.1	0.0547	308.6	26.5	468.5	156.9	0.24	0.11
21242	0.0632	39.5	30.1	0.0588	37.2	32.1	0.0632	39.5	30.1	0.0512	38.1	38.1	0.0547	308.6	26.5	462.9	156.9	0.24	0.11
21311	0.0651	38.6	29.4	0.0606	36.4	31.3	0.0608	33.5	31.2	0.0494	43.9	38.6	0.0536	29.8	26.9	182.3	157.4	0.24	0.11

21312	0.0651	38.6	29.4	0.0606	36.4	31.3	0.0608	33.5	31.2	0.0494	38.6	38.6	0.0536	29.8	26.9	177.0	157.4	0.24	0.11
21321	0.0652	38.6	29.3	0.0606	36.4	31.2	0.0608	33.5	31.1	0.0494	43.9	38.6	0.0534	27.0	27.0	179.4	157.4	0.24	0.11
21322	0.0652	38.6	29.3	0.0606	36.4	31.2	0.0608	33.5	31.1	0.0494	38.6	38.6	0.0534	27.0	27.0	174.1	157.4	0.24	0.11
21331	0.0604	41.1	31.4	0.0562	38.7	33.7	0.0567	35.7	33.4	0.0538	43.3	37.4	0.0667	39.7	23.0	198.3	158.8	0.24	0.11
21332	0.0604	41.1	31.4	0.0562	38.7	33.7	0.0567	35.7	33.4	0.0538	37.4	37.4	0.0667	39.7	23.0	192.5	158.8	0.24	0.11
21341	0.0643	39.0	29.7	0.0598	36.7	31.6	0.0601	33.8	31.5	0.0502	43.8	38.4	0.0557	308.1	26.1	461.4	157.2	0.24	0.11
21342	0.0643	39.0	29.7	0.0598	36.7	31.6	0.0601	33.8	31.5	0.0502	38.4	38.4	0.0557	308.1	26.1	456.0	157.2	0.24	0.11
21411	0.0649	38.7	29.4	0.0604	36.5	31.3	0.0611	31.0	31.0	0.0496	43.9	38.6	0.0535	29.9	27.0	179.9	157.3	0.24	0.11
21412	0.0649	38.7	29.4	0.0604	36.5	31.3	0.0611	31.0	31.0	0.0496	38.6	38.6	0.0535	29.9	27.0	174.6	157.3	0.24	0.11
21421	0.0650	38.6	29.4	0.0605	36.4	31.3	0.0612	31.0	31.0	0.0495	43.9	38.6	0.0533	27.1	27.1	177.0	157.4	0.24	0.11
21422	0.0650	38.6	29.4	0.0605	36.4	31.3	0.0612	31.0	31.0	0.0495	38.6	38.6	0.0533	27.1	27.1	171.7	157.4	0.24	0.11
21431	0.0603	41.1	31.4	0.0561	38.7	33.7	0.0569	33.2	33.2	0.0539	43.3	37.4	0.0666	39.7	23.0	196.0	158.7	0.24	0.11
21432	0.0603	41.1	31.4	0.0561	38.7	33.7	0.0569	33.2	33.2	0.0539	37.4	37.4	0.0666	39.7	23.0	190.1	158.7	0.24	0.11
21441	0.0642	39.0	29.7	0.0597	36.8	31.7	0.0605	31.3	31.3	0.0503	43.7	38.3	0.0556	308.2	26.1	459.1	157.2	0.24	0.11
21442	0.0642	39.0	29.7	0.0597	36.8	31.7	0.0605	31.3	31.3	0.0503	38.3	38.3	0.0556	308.2	26.1	453.6	157.2	0.24	0.11
22111	0.0639	39.2	29.8	0.0639	39.2	29.8	0.0595	36.9	31.8	0.0461	44.6	39.9	0.0526	30.3	27.4	190.1	158.7	0.24	0.11
22112	0.0639	39.2	29.8	0.0639	39.2	29.8	0.0595	36.9	31.8	0.0461	39.9	39.9	0.0526	30.3	27.4	185.4	158.7	0.24	0.11
22121	0.0640	39.1	29.8	0.0640	39.1	29.8	0.0595	36.9	31.8	0.0460	44.6	39.9	0.0524	27.5	27.5	187.3	158.8	0.24	0.11
22122	0.0640	39.1	29.8	0.0640	39.1	29.8	0.0595	36.9	31.8	0.0460	39.9	39.9	0.0524	27.5	27.5	182.6	158.8	0.24	0.11
22131	0.0595	41.6	31.8	0.0595	41.6	31.8	0.0554	39.2	34.2	0.0505	43.7	38.3	0.0656	40.3	23.2	206.4	159.3	0.24	0.11
22132	0.0595	41.6	31.8	0.0595	41.6	31.8	0.0554	39.2	34.2	0.0505	38.3	38.3	0.0656	40.3	23.2	201.0	159.3	0.24	0.11
22141	0.0632	39.5	30.1	0.0632	39.5	30.1	0.0588	37.2	32.1	0.0468	44.4	39.6	0.0547	308.6	26.5	469.3	158.4	0.24	0.11
22142	0.0632	39.5	30.1	0.0632	39.5	30.1	0.0588	37.2	32.1	0.0468	39.6	39.6	0.0547	308.6	26.5	464.5	158.4	0.24	0.11
22211	0.0628	39.7	30.3	0.0628	39.7	30.3	0.0628	39.7	30.3	0.0472	44.3	39.4	0.0517	30.8	27.9	194.3	158.1	0.24	0.11
22212	0.0628	39.7	30.3	0.0628	39.7	30.3	0.0628	39.7	30.3	0.0472	39.4	39.4	0.0517	30.8	27.9	189.4	158.1	0.24	0.11
22221	0.0628	39.7	30.3	0.0628	39.7	30.3	0.0628	39.7	30.3	0.0472	44.3	39.4	0.0515	27.9	27.9	191.4	158.2	0.24	0.11
22222	0.0628	39.7	30.3	0.0628	39.7	30.3	0.0628	39.7	30.3	0.0472	39.4	39.4	0.0515	27.9	27.9	186.5	158.2	0.24	0.11
22231	0.0585	42.2	32.3	0.0585	42.2	32.3	0.0585	42.2	32.3	0.0515	43.6	38.0	0.0643	41.1	23.5	211.3	158.4	0.24	0.11
22232	0.0585	42.2	32.3	0.0585	42.2	32.3	0.0585	42.2	32.3	0.0515	38.0	38.0	0.0643	41.1	23.5	205.7	158.4	0.24	0.11
22241	0.0621	40.1	30.6	0.0621	40.1	30.6	0.0621	40.1	30.6	0.0479	44.2	39.1	0.0537	309.1	26.9	473.6	157.8	0.24	0.11
22242	0.0621	40.1	30.6	0.0621	40.1	30.6	0.0621	40.1	30.6	0.0479	39.1	39.1	0.0537	309.1	26.9	468.6	157.8	0.24	0.11
22311	0.0639	39.2	29.8	0.0639	39.2	29.8	0.0597	34.0	31.7	0.0461	44.6	39.9	0.0526	30.3	27.4	187.3	158.7	0.24	0.11
22312	0.0639	39.2	29.8	0.0639	39.2	29.8	0.0597	34.0	31.7	0.0461	39.9	39.9	0.0526	30.3	27.4	182.6	158.7	0.24	0.11
22321	0.0639	39.2	29.8	0.0639	39.2	29.8	0.0598	34.0	31.7	0.0461	44.6	39.9	0.0524	27.5	27.5	184.4	158.7	0.24	0.11
22322	0.0639	39.2	29.8	0.0639	39.2	29.8	0.0598	34.0	31.7	0.0461	39.9	39.9	0.0524	27.5	27.5	179.7	158.7	0.24	0.11
22331	0.0594	41.7	31.9	0.0594	41.7	31.9	0.0558	36.2	33.9	0.0506	43.7	38.2	0.0654	40.4	23.3	203.6	159.1	0.24	0.11
22332	0.0594	41.7	31.9	0.0594	41.7	31.9	0.0558	36.2	33.9	0.0506	38.2	38.2	0.0654	40.4	23.3	198.2	159.1	0.24	0.11
22341	0.0631	39.6	30.1	0.0631	39.6	30.1	0.0591	34.3	32.0	0.0469	44.4	39.6	0.0546	308.6	26.5	466.5	158.3	0.24	0.11
22342	0.0631	39.6	30.1	0.0631	39.6	30.1	0.0591	34.3	32.0	0.0469	39.6	39.6	0.0546	308.6	26.5	461.6	158.3	0.24	0.11
22411	0.0637	39.3	29.9	0.0637	39.3	29.9	0.0600	31.5	31.5	0.0463	44.6	39.8	0.0525	30.4	27.5	185.0	158.6	0.24	0.11
22412	0.0637	39.3	29.9	0.0637	39.3	29.9	0.0600	31.5	31.5	0.0463	39.8	39.8	0.0525	30.4	27.5	180.2	158.6	0.24	0.11
22421	0.0638	39.2	29.9	0.0638	39.2	29.9	0.0601	31.5	31.5	0.0462	44.6	39.9	0.0523	27.5	27.5	182.1	158.6	0.24	0.11
22422	0.0638	39.2	29.9	0.0638	39.2	29.9	0.0601	31.5	31.5	0.0462	39.9	39.9	0.0523	27.5	27.5	177.4	158.6	0.24	0.11
22431	0.0593	41.7	31.9	0.0593	41.7	31.9	0.0560	33.7	33.7	0.0507	43.7	38.2	0.0653	40.5	23.3	201.3	159.0	0.24	0.11
22432	0.0593	41.7	31.9	0.0593	41.7	31.9	0.0560	33.7	33.7	0.0507	38.2	38.2	0.0653	40.5	23.3	195.9	159.0	0.24	0.11
22441	0.0630	39.6	30.2	0.0630	39.6	30.2	0.0594	31.9	31.9	0.0470	44.4	39.5	0.0545	308.7	26.5	464.1	158.3	0.24	0.11
22442	0.0630	39.6	30.2	0.0630	39.6	30.2	0.0594	31.9	31.9	0.0470	39.5	39.5	0.0545	308.7	26.5	459.3	158.3	0.24	0.11
23111	0.0651	38.6	29.4	0.0608	33.5	31.2	0.0606	36.4	31.3	0.0492	43.9	38.7	0.0536	29.8	26.9	182.3	157.5	0.24	0.11
23112	0.0651	38.6	29.4	0.0608	33.5	31.2	0.0606	36.4	31.3	0.0492	38.7	38.7	0.0536	29.8	26.9	177.1	157.5	0.24	0.11
23121	0.0652	38.6	29.3	0.0608	33.5	31.1	0.0606	36.4	31.2	0.0492	43.9	38.7	0.0534	27.0	27.0	179.4	157.5	0.24	0.11
23122	0.0652	38.6	29.3	0.0608	33.5	31.1	0.0606	36.4	31.2	0.0492	38.7	38.7	0.0534	27.0	27.0	174.2	157.5	0.24	0.11
23131	0.0604	41.1	31.4	0.0567	35.7	33.4	0.0562	38.7	33.7	0.0533	43.3	37.5	0.0667	39.7	23.0	198.4	158.9	0.24	0.11
23132	0.0604	41.1	31.4	0.0567	35.7	33.4	0.0562	38.7	33.7	0.0533	37.5	37.5	0.0667	39.7	23.0	192.6	158.9	0.24	0.11
23141	0.0643	39.0	29.7	0.0601	33.8	31.5	0.0598	36.7	31.6	0.0499	43.8	38.5	0.0557	308.1	26.1	461.5	157.3	0.24	0.11
23142	0.0643	39.0	29.7	0.0601	33.8	31.5	0.0598	36.7	31.6	0.0499	38.5	38.5	0.0557	308.1	26.1	456.1	157.3	0.24	0.11
23211	0.0639	39.2	29.8	0.0597	34.0	31.7	0.0639	39.2	29.8	0.0503	43.7	38.3	0.0526	30.3	27.4	186.5	157.1	0.24	0.11
23212	0.0639	39.2	29.8	0.0597	34.0	31.7	0.0639	39.2	29.8	0.0503	38.3	38.3	0.0526	30.3	27.4	181.1	157.1	0.24	0.11
23221	0.0639	39.2	29.8	0.0598	34.0	31.7	0.0639	39.2	29.8	0.0502	43.7	38.3	0.0524	27.5	27.5	183.6	157.1	0.24	0.11
23222	0.0639	39.2	29.8	0.0598	34.0	31.7	0.0639	39.2	29.8	0.0502	38.3	38.3	0.0524	27.5	27.5	178.2	157.1	0.24	0.11
23231	0.0594	41.7	31.9	0.0558	36.2	33.9	0.0594	41.7	31.9	0.0542	43.2	37.3	0.0654	40.4	23.3	203.2	158.2	0.24	0.11
23232	0.0594	41.7	31.9	0.0558	36.2	33.9	0.0594	41.7	31.9	0.0542	37.3	37.3	0.0654	40.4	23.3	197.3	158.2	0.24	0.11
23241	0.0631	39.6	30.1	0.0591	34.3	32.0	0.0631	39.6	30.1	0.0509	43.6	38.1	0.0546	308.6	26.5	465.7	156.9	0.24	0.11
23242	0.0631	39.6	30.1	0.0591	34.3	32.0	0.0631	39.6	30.1	0.0509	38.1	38.1	0.0546	308.6	26.5	460.2	156.9	0.24	0.11
23311	0.0650	38.6	29.4	0.0607	33.5	31.2	0.0607	33.5	31.2	0.0493	43.9	38.7	0.0535	29.9	27.0	179.5	157.4	0.24	0.11
23312	0.0650	38.6	29.4	0.0607	33.5	31.2	0.0607	33.5	31.2	0.0493	38.7	38.7	0.0535	29.9	27.0	174.3	157.4	0.24	0.11
23321	0.0651	38.6	29.4	0.0608	33.5	31.2	0.0608	33.5	31.2	0.0492	43.9	38.7	0.0533	27.1	27.1	176.6	157.5	0.24	0.11
23322	0.0651	38.6	29.4	0.0608	33.5	31.2	0.0608	33.5	31.2	0.0492	38.7	38.7	0.0533	27.1	27.1	171.4	157.5	0.24	0.11
23331	0.0603	41.1	31.4	0.0566	35.7	33.4	0.0566	35.7	33.4	0.0534	43.3	37.5	0.0666	39.8	23.0	195.6	158.8	0.24	0.11
23332	0.0603	41.1	31.4	0.0566	35.7	33.4	0.0566	35.7	33.4	0.0534	37.5	37.5	0.0666	39.8	23.0	189.8	158.8	0.24	0.11
23341	0.0643	39.0	29.7	0.0601	33.9	31.5	0.0601	33.9	31.5	0.0499	43.8	38.4	0.0556	308.1	26.1	458.6	157.3	0.24	0.11
23342	0.0643	39.0	29.7	0.0601	33.9	31.5	0.0601	33.9	31.5	0.0499	38.4	38.4	0.0556	308.1	26.1	453.3	157.3	0.24	0.11
23411	0.0649	38.7	29.5	0.0606	33.6	31.3	0.0611	31.0	31.0	0.0494	43.9	38.6	0.0534	29.9	27.0	177.2	157.4	0.24	0.11
23412	0.0649	38.7	29.5	0.0606	33.6	31.3	0.0611	31.0	31.0	0.0494	38.6	38.6	0.0534	29.9	27.0	171.9	157.4	0.24	0.11
23421	0.0650	38.7	29.4	0.0607	33.6	31.2	0.0611	31.0	31.0	0.0493	43.9	38.6	0.0532	27.1	27.1	174.3	157.4	0.24	0.11

23422	0.0650	38.7	29.4	0.0607	33.6	31.2	0.0611	31.0	31.0	0.0493	38.6	38.6	0.0532	27.1	27.1	169.0	157.4	0.24	0.11
23431	0.0602	41.2	31.5	0.0565	35.8	33.5	0.0568	33.3	33.3	0.0535	43.3	37.5	0.0665	39.8	23.1	193.3	158.7	0.24	0.11
23432	0.0602	41.2	31.5	0.0565	35.8	33.5	0.0568	33.3	33.3	0.0535	37.5	37.5	0.0665	39.8	23.1	187.5	158.7	0.24	0.11
23441	0.0641	39.1	29.7	0.0599	33.9	31.6	0.0604	31.4	31.4	0.0501	43.8	38.4	0.0555	308.2	26.1	456.3	157.2	0.24	0.11
23442	0.0641	39.1	29.7	0.0599	33.9	31.6	0.0604	31.4	31.4	0.0501	38.4	38.4	0.0555	308.2	26.1	450.9	157.2	0.24	0.11
24111	0.0649	38.7	29.4	0.0611	31.0	31.0	0.0604	36.5	31.3	0.0489	44.0	38.8	0.0535	29.9	27.0	180.0	157.6	0.24	0.11
24112	0.0649	38.7	29.4	0.0611	31.0	31.0	0.0604	36.5	31.3	0.0489	38.8	38.8	0.0535	29.9	27.0	174.9	157.6	0.24	0.11
24121	0.0650	38.6	29.4	0.0612	31.0	31.0	0.0605	36.4	31.3	0.0488	44.0	38.8	0.0533	27.1	27.1	177.2	157.6	0.24	0.11
24122	0.0650	38.6	29.4	0.0612	31.0	31.0	0.0605	36.4	31.3	0.0488	38.8	38.8	0.0533	27.1	27.1	172.0	157.6	0.24	0.11
24131	0.0603	41.1	31.4	0.0569	33.2	33.2	0.0561	38.7	33.7	0.0531	43.3	37.6	0.0666	39.7	23.0	196.1	158.9	0.24	0.11
24132	0.0603	41.1	31.4	0.0569	33.2	33.2	0.0561	38.7	33.7	0.0531	37.6	37.6	0.0666	39.7	23.0	190.3	158.9	0.24	0.11
24141	0.0642	39.0	29.7	0.0605	31.3	31.3	0.0597	36.8	31.7	0.0495	43.9	38.6	0.0556	308.2	26.1	459.2	157.4	0.24	0.11
24142	0.0642	39.0	29.7	0.0605	31.3	31.3	0.0597	36.8	31.7	0.0495	38.6	38.6	0.0556	308.2	26.1	453.9	157.4	0.24	0.11
24211	0.0637	39.3	29.9	0.0600	31.5	31.5	0.0637	39.3	29.9	0.0500	43.8	38.4	0.0525	30.4	27.5	184.2	157.2	0.24	0.11
24212	0.0637	39.3	29.9	0.0600	31.5	31.5	0.0637	39.3	29.9	0.0500	38.4	38.4	0.0525	30.4	27.5	178.8	157.2	0.24	0.11
24221	0.0638	39.2	29.9	0.0601	31.5	31.5	0.0638	39.2	29.9	0.0499	43.8	38.5	0.0523	27.5	27.5	181.3	157.2	0.24	0.11
24222	0.0638	39.2	29.9	0.0601	31.5	31.5	0.0638	39.2	29.9	0.0499	38.5	38.5	0.0523	27.5	27.5	175.9	157.2	0.24	0.11
24231	0.0593	41.7	31.9	0.0560	33.7	33.7	0.0593	41.7	31.9	0.0540	43.2	37.4	0.0653	40.5	23.3	200.9	158.2	0.24	0.11
24232	0.0593	41.7	31.9	0.0560	33.7	33.7	0.0593	41.7	31.9	0.0540	37.4	37.4	0.0653	40.5	23.3	195.0	158.2	0.24	0.11
24241	0.0630	39.6	30.2	0.0594	31.9	31.9	0.0630	39.6	30.2	0.0506	43.7	38.2	0.0545	308.7	26.5	463.4	157.0	0.24	0.11
24242	0.0630	39.6	30.2	0.0594	31.9	31.9	0.0630	39.6	30.2	0.0506	38.2	38.2	0.0545	308.7	26.5	458.0	157.0	0.24	0.11
24311	0.0649	38.7	29.5	0.0611	31.0	31.0	0.0606	33.6	31.3	0.0489	44.0	38.8	0.0534	29.9	27.0	177.2	157.5	0.24	0.11
24312	0.0649	38.7	29.5	0.0611	31.0	31.0	0.0606	33.6	31.3	0.0489	38.8	38.8	0.0534	29.9	27.0	172.0	157.5	0.24	0.11
24321	0.0650	38.7	29.4	0.0611	31.0	31.0	0.0607	33.6	31.2	0.0489	44.0	38.8	0.0532	27.1	27.1	174.4	157.6	0.24	0.11
24322	0.0650	38.7	29.4	0.0611	31.0	31.0	0.0607	33.6	31.2	0.0489	38.8	38.8	0.0532	27.1	27.1	169.2	157.6	0.24	0.11
24331	0.0602	41.2	31.5	0.0568	33.3	33.3	0.0565	35.8	33.5	0.0532	43.3	37.5	0.0665	39.8	23.1	193.3	158.8	0.24	0.11
24332	0.0602	41.2	31.5	0.0568	33.3	33.3	0.0565	35.8	33.5	0.0532	37.5	37.5	0.0665	39.8	23.1	187.6	158.8	0.24	0.11
24341	0.0641	39.1	29.7	0.0604	31.4	31.4	0.0599	33.9	31.6	0.0496	43.9	38.6	0.0555	308.2	26.1	456.4	157.3	0.24	0.11
24342	0.0641	39.1	29.7	0.0604	31.4	31.4	0.0599	33.9	31.6	0.0496	38.6	38.6	0.0555	308.2	26.1	451.1	157.3	0.24	0.11
24411	0.0648	38.8	29.5	0.0610	31.1	31.1	0.0610	31.1	31.1	0.0490	44.0	38.7	0.0533	30.0	27.1	174.9	157.5	0.24	0.11
24412	0.0648	38.8	29.5	0.0610	31.1	31.1	0.0610	31.1	31.1	0.0490	38.7	38.7	0.0533	30.0	27.1	169.6	157.5	0.24	0.11
24421	0.0648	38.7	29.5	0.0610	31.1	31.1	0.0610	31.1	31.1	0.0490	44.0	38.8	0.0531	27.2	27.2	172.0	157.5	0.24	0.11
24422	0.0648	38.7	29.5	0.0610	31.1	31.1	0.0610	31.1	31.1	0.0490	38.8	38.8	0.0531	27.2	27.2	166.8	157.5	0.24	0.11
24431	0.0601	41.2	31.5	0.0568	33.3	33.3	0.0568	33.3	33.3	0.0532	43.3	37.5	0.0664	39.9	23.1	191.0	158.7	0.24	0.11
24432	0.0601	41.2	31.5	0.0568	33.3	33.3	0.0568	33.3	33.3	0.0532	37.5	37.5	0.0664	39.9	23.1	185.2	158.7	0.24	0.11
24441	0.0640	39.1	29.8	0.0603	31.4	31.4	0.0603	31.4	31.4	0.0497	43.8	38.5	0.0554	308.2	26.2	454.0	157.3	0.24	0.11
24442	0.0640	39.1	29.8	0.0603	31.4	31.4	0.0603	31.4	31.4	0.0497	38.5	38.5	0.0554	308.2	26.2	448.7	157.3	0.24	0.11
31111	0.0619	33.0	30.7	0.0617	35.9	30.7	0.0617	35.9	30.7	0.0483	44.1	39.0	0.0546	29.4	26.5	178.3	157.6	0.24	0.11
31112	0.0619	33.0	30.7	0.0617	35.9	30.7	0.0617	35.9	30.7	0.0483	39.0	39.0	0.0546	29.4	26.5	173.2	157.6	0.24	0.11
31121	0.0620	33.0	30.6	0.0618	35.9	30.7	0.0618	35.9	30.7	0.0482	44.1	39.1	0.0544	26.6	26.6	175.4	157.7	0.24	0.11
31122	0.0620	33.0	30.6	0.0618	35.9	30.7	0.0618	35.9	30.7	0.0482	39.1	39.1	0.0544	26.6	26.6	170.4	157.7	0.24	0.11
31131	0.0576	35.1	32.8	0.0572	38.1	33.1	0.0572	38.1	33.1	0.0528	43.4	37.6	0.0681	38.9	22.8	193.7	159.4	0.24	0.11
31132	0.0576	35.1	32.8	0.0572	38.1	33.1	0.0572	38.1	33.1	0.0528	37.6	37.6	0.0681	38.9	22.8	187.9	159.4	0.24	0.11
31141	0.0612	33.3	31.0	0.0610	36.2	31.1	0.0610	36.2	31.1	0.0490	44.0	38.8	0.0568	307.6	25.7	457.3	157.5	0.24	0.11
31142	0.0612	33.3	31.0	0.0610	36.2	31.1	0.0610	36.2	31.1	0.0490	38.8	38.8	0.0568	307.6	25.7	452.1	157.5	0.24	0.11
31211	0.0608	33.5	31.2	0.0605	36.4	31.3	0.0651	38.6	29.4	0.0495	43.9	38.6	0.0536	29.8	27.0	182.3	157.4	0.24	0.11
31212	0.0608	33.5	31.2	0.0605	36.4	31.3	0.0651	38.6	29.4	0.0495	38.6	38.6	0.0536	29.8	27.0	177.0	157.4	0.24	0.11
31221	0.0608	33.5	31.2	0.0606	36.4	31.3	0.0651	38.6	29.4	0.0494	43.9	38.6	0.0533	27.1	27.1	179.4	157.4	0.24	0.11
31222	0.0608	33.5	31.2	0.0606	36.4	31.3	0.0651	38.6	29.4	0.0494	38.6	38.6	0.0533	27.1	27.1	174.1	157.4	0.24	0.11
31231	0.0567	35.7	33.4	0.0562	38.7	33.7	0.0604	41.1	31.4	0.0538	43.3	37.4	0.0667	39.7	23.0	198.3	158.8	0.24	0.11
31232	0.0567	35.7	33.4	0.0562	38.7	33.7	0.0604	41.1	31.4	0.0538	37.4	37.4	0.0667	39.7	23.0	192.5	158.8	0.24	0.11
31241	0.0601	33.8	31.5	0.0598	36.7	31.6	0.0643	39.0	29.7	0.0502	43.8	38.4	0.0557	308.1	26.1	461.4	157.2	0.24	0.11
31242	0.0601	33.8	31.5	0.0598	36.7	31.6	0.0643	39.0	29.7	0.0502	38.4	38.4	0.0557	308.1	26.1	456.0	157.2	0.24	0.11
31311	0.0618	33.0	30.7	0.0617	35.9	30.7	0.0618	33.0	30.7	0.0483	44.1	39.0	0.0546	29.4	26.5	175.5	157.6	0.24	0.11
31312	0.0618	33.0	30.7	0.0617	35.9	30.7	0.0618	33.0	30.7	0.0483	39.0	39.0	0.0546	29.4	26.5	170.4	157.6	0.24	0.11
31321	0.0619	33.0	30.7	0.0618	35.9	30.7	0.0619	33.0	30.7	0.0482	44.1	39.0	0.0543	26.6	26.6	172.6	157.7	0.24	0.11
31322	0.0619	33.0	30.7	0.0618	35.9	30.7	0.0619	33.0	30.7	0.0482	39.0	39.0	0.0543	26.6	26.6	167.5	157.7	0.24	0.11
31331	0.0575	35.2	32.9	0.0570	38.2	33.1	0.0575	35.2	32.9	0.0530	43.4	37.6	0.0679	39.0	22.8	190.9	159.3	0.24	0.11
31332	0.0575	35.2	32.9	0.0570	38.2	33.1	0.0575	35.2	32.9	0.0530	37.6	37.6	0.0679	39.0	22.8	185.1	159.3	0.24	0.11
31341	0.0611	33.4	31.0	0.0610	36.2	31.1	0.0611	33.4	31.0	0.0490	44.0	38.7	0.0567	307.6	25.7	454.5	157.5	0.24	0.11
31342	0.0611	33.4	31.0	0.0610	36.2	31.1	0.0611	33.4	31.0	0.0490	38.7	38.7	0.0567	307.6	25.7	449.3	157.5	0.24	0.11
31411	0.0617	33.1	30.7	0.0615	36.0	30.8	0.0622	30.5	30.5	0.0485	44.1	38.9	0.0545	29.4	26.6	173.1	157.6	0.24	0.11
31412	0.0617	33.1	30.7	0.0615	36.0	30.8	0.0622	30.5	30.5	0.0485	38.9	38.9	0.0545	29.4	26.6	168.0	157.6	0.24	0.11
31421	0.0618	33.1	30.7	0.0617	35.9	30.8	0.0623	30.5	30.5	0.0483	44.1	39.0	0.0542	26.7	26.7	170.2	157.6	0.24	0.11
31422	0.0618	33.1	30.7	0.0617	35.9	30.8	0.0623	30.5	30.5	0.0483	39.0	39.0	0.0542	26.7	26.7	165.1	157.6	0.24	0.11
31431	0.0574	35.2	32.9	0.0570	38.2	33.2	0.0578	32.7	32.7	0.0530	43.4	37.6	0.0678	39.0	22.8	188.6	159.2	0.24	0.11
31432	0.0574	35.2	32.9	0.0570	38.2	33.2	0.0578	32.7	32.7	0.0530	37.6	37.6	0.0678	39.0	22.8	182.8	159.2	0.24	0.11
31441	0.0610	33.4	31.1	0.0608	36.3	31.2	0.0615	30.8	30.8	0.0492	43.9	38.7	0.0566	307.7	25.7	452.1	157.5	0.24	0.11
31442	0.0610	33.4	31.1	0.0608	36.3	31.2	0.0615	30.8	30.8	0.0492	38.7	38.7	0.0566	307.7	25.7	446.9	157.5	0.24	0.11
32111	0.0608	33.5	31.2	0.0651	38.6	29.4	0.0605	36.4	31.3	0.0449	44.9	40.5	0.0536	29.8	27.0	183.3	159.3	0.24	0.11
32112	0.0608	33.5	31.2	0.0651	38.6	29.4	0.0605	36.4	31.3	0.0449	40.5	40.5	0.0536	29.8	27.0	178.9	159.3	0.24	0.11
32121	0.0608	33.5	31.2	0.0651	38.6	29.4	0.0606	36.4	31.3	0.0449	44.9	40.5	0.0533	27.1	27.1	180.5	159.3	0.24	0.11
32122	0.0608	33.5	31.2	0.0651	38.6	29.4	0.0606	36.4	31.3	0.0449	40.5	40.5	0.0533	27.1	27.1	176.0	159.3	0.24	0.11
32131	0.0567	35.7	33.4	0.0604	41.1	31.4	0.0562	38.7	33.7	0.0496	43.9	38.5	0.0667	39.7	23.0	198.9	159.9	0.24	0.11

32132	0.0567	35.7	33.4	0.0604	41.1	31.4	0.0562	38.7	33.7	0.0496	38.5	38.5	0.0667	39.7	23.0	193.6	159.9	0.24	0.11
32141	0.0601	33.8	31.5	0.0643	39.0	29.7	0.0598	36.7	31.6	0.0457	44.7	40.1	0.0557	308.1	26.1	462.4	159.0	0.24	0.11
32142	0.0601	33.8	31.5	0.0643	39.0	29.7	0.0598	36.7	31.6	0.0457	40.1	40.1	0.0557	308.1	26.1	457.8	159.0	0.24	0.11
32211	0.0597	34.0	31.7	0.0639	39.2	29.8	0.0639	39.2	29.8	0.0461	44.6	39.9	0.0526	30.3	27.4	187.3	158.7	0.24	0.11
32212	0.0597	34.0	31.7	0.0639	39.2	29.8	0.0639	39.2	29.8	0.0461	39.9	39.9	0.0526	30.3	27.4	182.6	158.7	0.24	0.11
32221	0.0597	34.0	31.7	0.0639	39.2	29.8	0.0639	39.2	29.8	0.0461	44.6	39.9	0.0524	27.5	27.5	184.5	158.7	0.24	0.11
32222	0.0597	34.0	31.7	0.0639	39.2	29.8	0.0639	39.2	29.8	0.0461	39.9	39.9	0.0524	27.5	27.5	179.8	158.7	0.24	0.11
32231	0.0558	36.2	33.9	0.0594	41.7	31.9	0.0594	41.7	31.9	0.0506	43.7	38.2	0.0654	40.4	23.3	203.6	159.1	0.24	0.11
32232	0.0558	36.2	33.9	0.0594	41.7	31.9	0.0594	41.7	31.9	0.0506	38.2	38.2	0.0654	40.4	23.3	198.2	159.1	0.24	0.11
32241	0.0591	34.3	32.0	0.0631	39.6	30.1	0.0631	39.6	30.1	0.0469	44.4	39.6	0.0546	308.6	26.5	466.5	158.4	0.24	0.11
32242	0.0591	34.3	32.0	0.0631	39.6	30.1	0.0631	39.6	30.1	0.0469	39.6	39.6	0.0546	308.6	26.5	461.7	158.4	0.24	0.11
32311	0.0607	33.5	31.2	0.0650	38.6	29.4	0.0607	33.5	31.2	0.0450	44.9	40.5	0.0535	29.9	27.0	180.5	159.2	0.24	0.11
32312	0.0607	33.5	31.2	0.0650	38.6	29.4	0.0607	33.5	31.2	0.0450	40.5	40.5	0.0535	29.9	27.0	176.0	159.2	0.24	0.11
32321	0.0608	33.5	31.2	0.0651	38.6	29.4	0.0608	33.5	31.2	0.0449	44.9	40.5	0.0533	27.1	27.1	177.6	159.3	0.24	0.11
32322	0.0608	33.5	31.2	0.0651	38.6	29.4	0.0608	33.5	31.2	0.0449	40.5	40.5	0.0533	27.1	27.1	173.2	159.3	0.24	0.11
32331	0.0566	35.7	33.4	0.0603	41.1	31.4	0.0566	35.7	33.4	0.0497	43.8	38.5	0.0666	39.8	23.0	196.1	159.8	0.24	0.11
32332	0.0566	35.7	33.4	0.0603	41.1	31.4	0.0566	35.7	33.4	0.0497	38.5	38.5	0.0666	39.8	23.0	190.8	159.8	0.24	0.11
32341	0.0600	33.9	31.5	0.0643	39.0	29.7	0.0600	33.9	31.5	0.0458	44.7	40.1	0.0556	308.1	26.1	459.6	158.9	0.24	0.11
32342	0.0600	33.9	31.5	0.0643	39.0	29.7	0.0600	33.9	31.5	0.0458	40.1	40.1	0.0556	308.1	26.1	454.9	158.9	0.24	0.11
32411	0.0606	33.6	31.3	0.0649	38.7	29.4	0.0611	31.0	31.0	0.0451	44.9	40.4	0.0534	29.9	27.0	178.1	159.1	0.24	0.11
32412	0.0606	33.6	31.3	0.0649	38.7	29.4	0.0611	31.0	31.0	0.0451	40.4	40.4	0.0534	29.9	27.0	173.6	159.1	0.24	0.11
32421	0.0607	33.6	31.2	0.0650	38.7	29.4	0.0611	31.0	31.0	0.0450	44.9	40.4	0.0532	27.1	27.1	175.2	159.2	0.24	0.11
32422	0.0607	33.6	31.2	0.0650	38.7	29.4	0.0611	31.0	31.0	0.0450	40.4	40.4	0.0532	27.1	27.1	170.8	159.2	0.24	0.11
32431	0.0565	35.8	33.5	0.0602	41.2	31.5	0.0568	33.3	33.3	0.0498	43.8	38.5	0.0664	39.8	23.1	193.8	159.7	0.24	0.11
32432	0.0565	35.8	33.5	0.0602	41.2	31.5	0.0568	33.3	33.3	0.0498	38.5	38.5	0.0664	39.8	23.1	188.5	159.7	0.24	0.11
32441	0.0599	33.9	31.6	0.0641	39.1	29.7	0.0604	31.4	31.4	0.0459	44.7	40.0	0.0555	308.2	26.1	457.2	158.8	0.24	0.11
32442	0.0599	33.9	31.6	0.0641	39.1	29.7	0.0604	31.4	31.4	0.0459	40.0	40.0	0.0555	308.2	26.1	452.5	158.8	0.24	0.11
33111	0.0618	33.0	30.7	0.0618	33.0	30.7	0.0617	35.9	30.7	0.0482	44.1	39.1	0.0546	29.4	26.5	175.5	157.7	0.24	0.11
33112	0.0618	33.0	30.7	0.0618	33.0	30.7	0.0617	35.9	30.7	0.0482	39.1	39.1	0.0546	29.4	26.5	170.4	157.7	0.24	0.11
33121	0.0619	33.0	30.7	0.0619	33.0	30.7	0.0618	35.9	30.7	0.0481	44.1	39.1	0.0543	26.6	26.6	172.7	157.7	0.24	0.11
33122	0.0619	33.0	30.7	0.0619	33.0	30.7	0.0618	35.9	30.7	0.0481	39.1	39.1	0.0543	26.6	26.6	167.6	157.7	0.24	0.11
33131	0.0575	35.2	32.9	0.0575	35.2	32.9	0.0570	38.2	33.1	0.0525	43.4	37.7	0.0679	39.0	22.8	190.9	159.4	0.24	0.11
33132	0.0575	35.2	32.9	0.0575	35.2	32.9	0.0570	38.2	33.1	0.0525	37.7	37.7	0.0679	39.0	22.8	185.2	159.4	0.24	0.11
33141	0.0611	33.4	31.0	0.0611	33.4	31.0	0.0610	36.2	31.1	0.0489	44.0	38.8	0.0567	307.6	25.7	454.6	157.6	0.24	0.11
33142	0.0611	33.4	31.0	0.0611	33.4	31.0	0.0610	36.2	31.1	0.0489	38.8	38.8	0.0567	307.6	25.7	449.4	157.6	0.24	0.11
33211	0.0607	33.5	31.2	0.0607	33.5	31.2	0.0650	38.6	29.4	0.0493	43.9	38.7	0.0535	29.9	27.0	179.5	157.4	0.24	0.11
33212	0.0607	33.5	31.2	0.0607	33.5	31.2	0.0650	38.6	29.4	0.0493	38.7	38.7	0.0535	29.9	27.0	174.2	157.4	0.24	0.11
33221	0.0608	33.5	31.2	0.0608	33.5	31.2	0.0651	38.6	29.4	0.0492	43.9	38.7	0.0533	27.1	27.1	176.6	157.5	0.24	0.11
33222	0.0608	33.5	31.2	0.0608	33.5	31.2	0.0651	38.6	29.4	0.0492	38.7	38.7	0.0533	27.1	27.1	171.4	157.5	0.24	0.11
33231	0.0566	35.7	33.4	0.0566	35.7	33.4	0.0603	41.1	31.4	0.0534	43.3	37.5	0.0666	39.8	23.0	195.6	158.8	0.24	0.11
33232	0.0566	35.7	33.4	0.0566	35.7	33.4	0.0603	41.1	31.4	0.0534	37.5	37.5	0.0666	39.8	23.0	189.8	158.8	0.24	0.11
33241	0.0600	33.9	31.5	0.0600	33.9	31.5	0.0643	39.0	29.7	0.0500	43.8	38.4	0.0556	308.1	26.1	458.7	157.3	0.24	0.11
33242	0.0600	33.9	31.5	0.0600	33.9	31.5	0.0643	39.0	29.7	0.0500	38.4	38.4	0.0556	308.1	26.1	453.3	157.3	0.24	0.11
33311	0.0618	33.1	30.7	0.0618	33.1	30.7	0.0618	33.1	30.7	0.0482	44.1	39.0	0.0546	29.4	26.5	172.7	157.7	0.24	0.11
33312	0.0618	33.1	30.7	0.0618	33.1	30.7	0.0618	33.1	30.7	0.0482	39.0	39.0	0.0546	29.4	26.5	167.6	157.7	0.24	0.11
33321	0.0619	33.0	30.7	0.0619	33.0	30.7	0.0619	33.0	30.7	0.0481	44.1	39.1	0.0543	26.6	26.6	169.9	157.7	0.24	0.11
33322	0.0619	33.0	30.7	0.0619	33.0	30.7	0.0619	33.0	30.7	0.0481	39.1	39.1	0.0543	26.6	26.6	164.8	157.7	0.24	0.11
33331	0.0574	35.2	32.9	0.0574	35.2	32.9	0.0574	35.2	32.9	0.0526	43.4	37.7	0.0678	39.1	22.8	188.2	159.3	0.24	0.11
33332	0.0574	35.2	32.9	0.0574	35.2	32.9	0.0574	35.2	32.9	0.0526	37.7	37.7	0.0678	39.1	22.8	182.5	159.3	0.24	0.11
33341	0.0611	33.4	31.0	0.0611	33.4	31.0	0.0611	33.4	31.0	0.0489	44.0	38.8	0.0567	307.6	25.7	451.7	157.5	0.24	0.11
33342	0.0611	33.4	31.0	0.0611	33.4	31.0	0.0611	33.4	31.0	0.0489	38.8	38.8	0.0567	307.6	25.7	446.5	157.5	0.24	0.11
33411	0.0617	33.1	30.8	0.0617	33.1	30.8	0.0622	30.5	30.5	0.0483	44.1	39.0	0.0544	29.5	26.6	170.3	157.6	0.24	0.11
33412	0.0617	33.1	30.8	0.0617	33.1	30.8	0.0622	30.5	30.5	0.0483	39.0	39.0	0.0544	29.5	26.6	165.2	157.6	0.24	0.11
33421	0.0618	33.1	30.7	0.0618	33.1	30.7	0.0623	30.5	30.5	0.0482	44.1	39.0	0.0542	26.7	26.7	167.5	157.6	0.24	0.11
33422	0.0618	33.1	30.7	0.0618	33.1	30.7	0.0623	30.5	30.5	0.0482	39.0	39.0	0.0542	26.7	26.7	162.4	157.6	0.24	0.11
33431	0.0573	35.3	33.0	0.0573	35.3	33.0	0.0577	32.8	32.8	0.0527	43.4	37.7	0.0677	39.1	22.8	185.9	159.2	0.24	0.11
33432	0.0573	35.3	33.0	0.0573	35.3	33.0	0.0577	32.8	32.8	0.0527	37.7	37.7	0.0677	39.1	22.8	180.1	159.2	0.24	0.11
33441	0.0610	33.4	31.1	0.0610	33.4	31.1	0.0615	30.9	30.9	0.0490	44.0	38.7	0.0565	307.7	25.7	449.4	157.5	0.24	0.11
33442	0.0610	33.4	31.1	0.0610	33.4	31.1	0.0615	30.9	30.9	0.0490	38.7	38.7	0.0565	307.7	25.7	444.1	157.5	0.24	0.11
34111	0.0617	33.1	30.7	0.0622	30.5	30.5	0.0615	36.0	30.8	0.0478	44.2	39.2	0.0545	29.4	26.6	173.3	157.8	0.24	0.11
34112	0.0617	33.1	30.7	0.0622	30.5	30.5	0.0615	36.0	30.8	0.0478	39.2	39.2	0.0545	29.4	26.6	168.2	157.8	0.24	0.11
34121	0.0618	33.1	30.7	0.0623	30.5	30.5	0.0617	35.9	30.8	0.0477	44.2	39.2	0.0542	26.7	26.7	170.4	157.9	0.24	0.11
34122	0.0618	33.1	30.7	0.0623	30.5	30.5	0.0617	35.9	30.8	0.0477	39.2	39.2	0.0542	26.7	26.7	165.4	157.9	0.24	0.11
34131	0.0574	35.2	32.9	0.0578	32.7	32.7	0.0570	38.2	33.2	0.0522	43.5	37.8	0.0678	39.0	22.8	188.7	159.4	0.24	0.11
34132	0.0574	35.2	32.9	0.0578	32.7	32.7	0.0570	38.2	33.2	0.0522	37.8	37.8	0.0678	39.0	22.8	183.0	159.4	0.24	0.11
34141	0.0610	33.4	31.1	0.0615	30.8	30.8	0.0608	36.3	31.2	0.0485	44.1	38.9	0.0566	307.7	25.7	452.3	157.7	0.24	0.11
34142	0.0610	33.4	31.1	0.0615	30.8	30.8	0.0608	36.3	31.2	0.0485	38.9	38.9	0.0566	307.7	25.7	447.1	157.7	0.24	0.11
34211	0.0606	33.6	31.3	0.0611	31.0	31.0	0.0649	38.7	29.4	0.0489	44.0	38.8	0.0534	29.9	27.0	177.2	157.5	0.24	0.11
34212	0.0606	33.6	31.3	0.0611	31.0	31.0	0.0649	38.7	29.4	0.0489	38.8	38.8	0.0534	29.9	27.0	172.0	157.5	0.24	0.11
34221	0.0607	33.6	31.2	0.0611	31.0	31.0	0.0650	38.7	29.4	0.0489	44.0	38.8	0.0532	27.1	27.1	174.4	157.6	0.24	0.11
34222	0.0607	33.6	31.2	0.0611	31.0	31.0	0.0650	38.7	29.4	0.0489	38.8	38.8	0.0532	27.1	27.1	169.2	157.6	0.24	0.11
34231	0.0565	35.8	33.5	0.0568	33.3	33.3	0.0602	41.2	31.5	0.0532	43.3	37.5	0.0664	39.8	23.1	193.4	158.8	0.24	0.11
34232	0.0565	35.8	33.5	0.0568	33.3	33.3	0.0602	41.2	31.5	0.0532	37.5	37.5	0.0664	39.8	23.1	187.6	158.8	0.24	0.11
34241	0.0599	33.9	31.6	0.0604	31.4	31.4	0.0641	39.1	29.7	0.0496	43.9	38.5	0.0555	308.2	26.1	456.4	157.3	0.24	0.11

34242	0.0599	33.9	31.6	0.0604	31.4	31.4	0.0641	39.1	29.7	0.0496	38.5	38.5	0.0555	308.2	26.1	451.1	157.3	0.24	0.11
34311	0.0617	33.1	30.8	0.0622	30.5	30.5	0.0617	33.1	30.8	0.0478	44.2	39.2	0.0544	29.5	26.6	170.4	157.8	0.24	0.11
34312	0.0617	33.1	30.8	0.0622	30.5	30.5	0.0617	33.1	30.8	0.0478	39.2	39.2	0.0544	29.5	26.6	165.4	157.8	0.24	0.11
34321	0.0618	33.1	30.7	0.0623	30.5	30.5	0.0618	33.1	30.7	0.0477	44.2	39.2	0.0542	26.7	26.7	167.6	157.8	0.24	0.11
34322	0.0618	33.1	30.7	0.0623	30.5	30.5	0.0618	33.1	30.7	0.0477	39.2	39.2	0.0542	26.7	26.7	162.6	157.8	0.24	0.11
34331	0.0573	35.3	33.0	0.0577	32.8	32.8	0.0573	35.3	33.0	0.0523	43.4	37.8	0.0677	39.1	22.8	185.9	159.3	0.24	0.11
34332	0.0573	35.3	33.0	0.0577	32.8	32.8	0.0573	35.3	33.0	0.0523	37.8	37.8	0.0677	39.1	22.8	180.2	159.3	0.24	0.11
34341	0.0610	33.4	31.1	0.0615	30.9	30.9	0.0610	33.4	31.1	0.0485	44.1	38.9	0.0565	307.7	25.7	449.5	157.7	0.24	0.11
34342	0.0610	33.4	31.1	0.0615	30.9	30.9	0.0610	33.4	31.1	0.0485	38.9	38.9	0.0565	307.7	25.7	444.3	157.7	0.24	0.11
34411	0.0615	33.2	30.8	0.0620	30.6	30.6	0.0620	30.6	30.6	0.0480	44.2	39.1	0.0543	29.5	26.6	168.0	157.8	0.24	0.11
34412	0.0615	33.2	30.8	0.0620	30.6	30.6	0.0620	30.6	30.6	0.0480	39.1	39.1	0.0543	29.5	26.6	163.0	157.8	0.24	0.11
34421	0.0616	33.1	30.8	0.0621	30.6	30.6	0.0621	30.6	30.6	0.0479	44.2	39.2	0.0541	26.7	26.7	165.2	157.8	0.24	0.11
34422	0.0616	33.1	30.8	0.0621	30.6	30.6	0.0621	30.6	30.6	0.0479	39.2	39.2	0.0541	26.7	26.7	160.2	157.8	0.24	0.11
34431	0.0572	35.3	33.0	0.0576	32.8	32.8	0.0576	32.8	32.8	0.0524	43.4	37.7	0.0675	39.2	22.9	183.6	159.3	0.24	0.11
34432	0.0572	35.3	33.0	0.0576	32.8	32.8	0.0576	32.8	32.8	0.0524	37.7	37.7	0.0675	39.2	22.9	177.9	159.3	0.24	0.11
34441	0.0609	33.5	31.1	0.0613	30.9	30.9	0.0613	30.9	30.9	0.0487	44.0	38.9	0.0564	307.7	25.8	447.1	157.6	0.24	0.11
34442	0.0609	33.5	31.1	0.0613	30.9	30.9	0.0613	30.9	30.9	0.0487	38.9	38.9	0.0564	307.7	25.8	441.9	157.6	0.24	0.11
41111	0.0623	30.5	30.5	0.0616	35.9	30.8	0.0616	35.9	30.8	0.0484	44.1	39.0	0.0545	29.4	26.5	175.9	157.6	0.24	0.11
41112	0.0623	30.5	30.5	0.0616	35.9	30.8	0.0616	35.9	30.8	0.0484	39.0	39.0	0.0545	29.4	26.5	170.8	157.6	0.24	0.11
41121	0.0623	30.5	30.5	0.0617	35.9	30.8	0.0617	35.9	30.8	0.0483	44.1	39.0	0.0542	26.7	26.7	173.0	157.6	0.24	0.11
41122	0.0623	30.5	30.5	0.0617	35.9	30.8	0.0617	35.9	30.8	0.0483	39.0	39.0	0.0542	26.7	26.7	167.9	157.6	0.24	0.11
41131	0.0579	32.7	32.7	0.0571	38.2	33.1	0.0571	38.2	33.1	0.0529	43.4	37.6	0.0680	38.9	22.8	191.3	159.3	0.24	0.11
41132	0.0579	32.7	32.7	0.0571	38.2	33.1	0.0571	38.2	33.1	0.0529	37.6	37.6	0.0680	38.9	22.8	185.6	159.3	0.24	0.11
41141	0.0616	30.8	30.8	0.0609	36.3	31.1	0.0609	36.3	31.1	0.0491	43.9	38.7	0.0566	307.7	25.7	454.9	157.5	0.24	0.11
41142	0.0616	30.8	30.8	0.0609	36.3	31.1	0.0609	36.3	31.1	0.0491	38.7	38.7	0.0566	307.7	25.7	449.7	157.5	0.24	0.11
41211	0.0611	31.0	31.0	0.0604	36.5	31.3	0.0649	38.7	29.4	0.0496	43.9	38.6	0.0535	29.9	27.0	179.9	157.3	0.24	0.11
41212	0.0611	31.0	31.0	0.0604	36.5	31.3	0.0649	38.7	29.4	0.0496	38.6	38.6	0.0535	29.9	27.0	174.6	157.3	0.24	0.11
41221	0.0612	31.0	31.0	0.0605	36.4	31.3	0.0650	38.6	29.4	0.0495	43.9	38.6	0.0533	27.1	27.1	177.0	157.4	0.24	0.11
41222	0.0612	31.0	31.0	0.0605	36.4	31.3	0.0650	38.6	29.4	0.0495	38.6	38.6	0.0533	27.1	27.1	171.7	157.4	0.24	0.11
41231	0.0569	33.2	33.2	0.0561	38.7	33.7	0.0603	41.1	31.4	0.0539	43.3	37.4	0.0666	39.7	23.0	196.0	158.7	0.24	0.11
41232	0.0569	33.2	33.2	0.0561	38.7	33.7	0.0603	41.1	31.4	0.0539	37.4	37.4	0.0666	39.7	23.0	190.1	158.7	0.24	0.11
41241	0.0605	31.3	31.3	0.0597	36.8	31.7	0.0642	39.0	29.7	0.0503	43.7	38.3	0.0556	308.2	26.1	459.0	157.2	0.24	0.11
41242	0.0605	31.3	31.3	0.0597	36.8	31.7	0.0642	39.0	29.7	0.0503	38.3	38.3	0.0556	308.2	26.1	453.6	157.2	0.24	0.11
41311	0.0622	30.5	30.5	0.0616	36.0	30.8	0.0617	33.1	30.7	0.0484	44.1	39.0	0.0545	29.4	26.6	173.1	157.6	0.24	0.11
41312	0.0622	30.5	30.5	0.0616	36.0	30.8	0.0617	33.1	30.7	0.0484	39.0	39.0	0.0545	29.4	26.6	168.0	157.6	0.24	0.11
41321	0.0623	30.5	30.5	0.0616	35.9	30.8	0.0618	33.1	30.7	0.0484	44.1	39.0	0.0542	26.7	26.7	170.2	157.6	0.24	0.11
41322	0.0623	30.5	30.5	0.0616	35.9	30.8	0.0618	33.1	30.7	0.0484	39.0	39.0	0.0542	26.7	26.7	165.1	157.6	0.24	0.11
41331	0.0578	32.7	32.7	0.0570	38.2	33.2	0.0574	35.2	32.9	0.0530	43.4	37.6	0.0678	39.0	22.8	188.6	159.2	0.24	0.11
41332	0.0578	32.7	32.7	0.0570	38.2	33.2	0.0574	35.2	32.9	0.0530	37.6	37.6	0.0678	39.0	22.8	182.8	159.2	0.24	0.11
41341	0.0615	30.8	30.8	0.0608	36.3	31.1	0.0610	33.4	31.1	0.0492	43.9	38.7	0.0566	307.7	25.7	452.1	157.4	0.24	0.11
41342	0.0615	30.8	30.8	0.0608	36.3	31.1	0.0610	33.4	31.1	0.0492	38.7	38.7	0.0566	307.7	25.7	446.9	157.4	0.24	0.11
41411	0.0621	30.6	30.6	0.0614	36.0	30.9	0.0621	30.6	30.6	0.0486	44.0	38.9	0.0544	29.5	26.6	170.7	157.5	0.24	0.11
41412	0.0621	30.6	30.6	0.0614	36.0	30.9	0.0621	30.6	30.6	0.0486	38.9	38.9	0.0544	29.5	26.6	165.6	157.5	0.24	0.11
41421	0.0622	30.5	30.5	0.0615	36.0	30.8	0.0622	30.5	30.5	0.0485	44.1	38.9	0.0541	26.7	26.7	167.8	157.6	0.24	0.11
41422	0.0622	30.5	30.5	0.0615	36.0	30.8	0.0622	30.5	30.5	0.0485	38.9	38.9	0.0541	26.7	26.7	162.7	157.6	0.24	0.11
41431	0.0577	32.8	32.8	0.0569	38.3	33.2	0.0577	32.8	32.8	0.0531	43.3	37.6	0.0677	39.1	22.8	186.2	159.1	0.24	0.11
41432	0.0577	32.8	32.8	0.0569	38.3	33.2	0.0577	32.8	32.8	0.0531	37.6	37.6	0.0677	39.1	22.8	180.5	159.1	0.24	0.11
41441	0.0614	30.9	30.9	0.0607	36.3	31.2	0.0614	30.9	30.9	0.0493	43.9	38.7	0.0565	307.7	25.8	449.7	157.4	0.24	0.11
41442	0.0614	30.9	30.9	0.0607	36.3	31.2	0.0614	30.9	30.9	0.0493	38.7	38.7	0.0565	307.7	25.8	444.5	157.4	0.24	0.11
42111	0.0611	31.0	31.0	0.0649	38.7	29.4	0.0604	36.5	31.3	0.0451	44.9	40.4	0.0535	29.9	27.0	180.9	159.2	0.24	0.11
42112	0.0611	31.0	31.0	0.0649	38.7	29.4	0.0604	36.5	31.3	0.0451	40.4	40.4	0.0535	29.9	27.0	176.5	159.2	0.24	0.11
42121	0.0612	31.0	31.0	0.0650	38.6	29.4	0.0605	36.4	31.3	0.0450	44.9	40.5	0.0533	27.1	27.1	178.0	159.2	0.24	0.11
42122	0.0612	31.0	31.0	0.0650	38.6	29.4	0.0605	36.4	31.3	0.0450	40.5	40.5	0.0533	27.1	27.1	173.6	159.2	0.24	0.11
42131	0.0569	33.2	33.2	0.0603	41.1	31.4	0.0561	38.7	33.7	0.0497	43.8	38.5	0.0666	39.7	23.0	196.6	159.8	0.24	0.11
42132	0.0569	33.2	33.2	0.0603	41.1	31.4	0.0561	38.7	33.7	0.0497	38.5	38.5	0.0666	39.7	23.0	191.3	159.8	0.24	0.11
42141	0.0605	31.3	31.3	0.0642	39.0	29.7	0.0597	36.8	31.7	0.0458	44.7	40.1	0.0556	308.2	26.1	460.0	158.9	0.24	0.11
42142	0.0605	31.3	31.3	0.0642	39.0	29.7	0.0597	36.8	31.7	0.0458	40.1	40.1	0.0556	308.2	26.1	455.4	158.9	0.24	0.11
42211	0.0600	31.5	31.5	0.0637	39.3	29.9	0.0637	39.3	29.9	0.0463	44.6	39.8	0.0525	30.4	27.5	185.0	158.6	0.24	0.11
42212	0.0600	31.5	31.5	0.0637	39.3	29.9	0.0637	39.3	29.9	0.0463	39.8	39.8	0.0525	30.4	27.5	180.2	158.6	0.24	0.11
42221	0.0601	31.5	31.5	0.0638	39.2	29.9	0.0638	39.2	29.9	0.0462	44.6	39.9	0.0523	27.6	27.6	182.1	158.7	0.24	0.11
42222	0.0601	31.5	31.5	0.0638	39.2	29.9	0.0638	39.2	29.9	0.0462	39.9	39.9	0.0523	27.6	27.6	177.4	158.7	0.24	0.11
42231	0.0560	33.7	33.7	0.0593	41.7	31.9	0.0593	41.7	31.9	0.0507	43.7	38.2	0.0653	40.5	23.3	201.3	159.0	0.24	0.11
42232	0.0560	33.7	33.7	0.0593	41.7	31.9	0.0593	41.7	31.9	0.0507	38.2	38.2	0.0653	40.5	23.3	195.9	159.0	0.24	0.11
42241	0.0594	31.8	31.8	0.0630	39.6	30.2	0.0630	39.6	30.2	0.0470	44.4	39.5	0.0545	308.7	26.5	464.1	158.3	0.24	0.11
42242	0.0594	31.8	31.8	0.0630	39.6	30.2	0.0630	39.6	30.2	0.0470	39.5	39.5	0.0545	308.7	26.5	459.3	158.3	0.24	0.11
42311	0.0611	31.0	31.0	0.0649	38.7	29.4	0.0606	33.6	31.3	0.0451	44.9	40.4	0.0534	29.9	27.0	178.1	159.1	0.24	0.11
42312	0.0611	31.0	31.0	0.0649	38.7	29.4	0.0606	33.6	31.3	0.0451	40.4	40.4	0.0534	29.9	27.0	173.6	159.1	0.24	0.11
42321	0.0611	31.0	31.0	0.0650	38.7	29.4	0.0607	33.6	31.2	0.0450	44.9	40.4	0.0532	27.1	27.1	175.2	159.2	0.24	0.11
42322	0.0611	31.0	31.0	0.0650	38.7	29.4	0.0607	33.6	31.2	0.0450	40.4	40.4	0.0532	27.1	27.1	170.8	159.2	0.24	0.11
42331	0.0568	33.3	33.3	0.0602	41.2	31.5	0.0565	35.8	33.5	0.0498	43.8	38.5	0.0665	39.8	23.1	193.8	159.7	0.24	0.11
42332	0.0568	33.3	33.3	0.0602	41.2	31.5	0.0565	35.8	33.5	0.0498	38.5	38.5	0.0665	39.8	23.1	188.5	159.7	0.24	0.11
42341	0.0604	31.4	31.4	0.0641	39.1	29.7	0.0599	33.9	31.6	0.0459	44.7	40.0	0.0555	308.2	26.1	457.2	158.8	0.24	0.11
42342	0.0604	31.4	31.4	0.0641	39.1	29.7	0.0599	33.9	31.6	0.0459	40.0	40.0	0.0555	308.2	26.1	452.5	158.8	0.24	0.11
42411	0.0610	31.1	31.1	0.0648	38.8	29.5	0.0610	31.1	31.1	0.0452	44.8	40.3	0.0533	30.0	27.1	175.7	159.1	0.24	0.11

42412	0.0610	31.1	31.1	0.0648	38.8	29.5	0.0610	31.1	31.1	0.0452	40.3	40.3	0.0533	30.0	27.1	171.2	159.1	0.24	0.11
42421	0.0610	31.1	31.1	0.0648	38.7	29.5	0.0610	31.1	31.1	0.0452	44.8	40.4	0.0531	27.2	27.2	172.9	159.1	0.24	0.11
42422	0.0610	31.1	31.1	0.0648	38.7	29.5	0.0610	31.1	31.1	0.0452	40.4	40.4	0.0531	27.2	27.2	168.4	159.1	0.24	0.11
42431	0.0568	33.3	33.3	0.0601	41.2	31.5	0.0568	33.3	33.3	0.0499	43.8	38.5	0.0664	39.9	23.1	191.5	159.6	0.24	0.11
42432	0.0568	33.3	33.3	0.0601	41.2	31.5	0.0568	33.3	33.3	0.0499	38.5	38.5	0.0664	39.9	23.1	186.2	159.6	0.24	0.11
42441	0.0603	31.4	31.4	0.0640	39.1	29.8	0.0603	31.4	31.4	0.0460	44.6	40.0	0.0554	308.2	26.2	454.8	158.7	0.24	0.11
42442	0.0603	31.4	31.4	0.0640	39.1	29.8	0.0603	31.4	31.4	0.0460	40.0	40.0	0.0554	308.2	26.2	450.1	158.7	0.24	0.11
43111	0.0622	30.5	30.5	0.0617	33.1	30.7	0.0616	36.0	30.8	0.0483	44.1	39.0	0.0545	29.4	26.6	173.1	157.6	0.24	0.11
43112	0.0622	30.5	30.5	0.0617	33.1	30.7	0.0616	36.0	30.8	0.0483	39.0	39.0	0.0545	29.4	26.6	168.0	157.6	0.24	0.11
43121	0.0623	30.5	30.5	0.0618	33.1	30.7	0.0616	35.9	30.8	0.0482	44.1	39.0	0.0542	26.7	26.7	170.3	157.7	0.24	0.11
43122	0.0623	30.5	30.5	0.0618	33.1	30.7	0.0616	35.9	30.8	0.0482	39.0	39.0	0.0542	26.7	26.7	165.2	157.7	0.24	0.11
43131	0.0578	32.7	32.7	0.0574	35.2	32.9	0.0570	38.2	33.2	0.0526	43.4	37.7	0.0678	39.0	22.8	188.6	159.3	0.24	0.11
43132	0.0578	32.7	32.7	0.0574	35.2	32.9	0.0570	38.2	33.2	0.0526	37.7	37.7	0.0678	39.0	22.8	182.9	159.3	0.24	0.11
43141	0.0615	30.8	30.8	0.0610	33.4	31.1	0.0608	36.3	31.1	0.0490	44.0	38.8	0.0566	307.7	25.7	452.2	157.5	0.24	0.11
43142	0.0615	30.8	30.8	0.0610	33.4	31.1	0.0608	36.3	31.1	0.0490	38.8	38.8	0.0566	307.7	25.7	447.0	157.5	0.24	0.11
43211	0.0611	31.0	31.0	0.0606	33.6	31.3	0.0649	38.7	29.4	0.0494	43.9	38.6	0.0534	29.9	27.0	177.1	157.4	0.24	0.11
43212	0.0611	31.0	31.0	0.0606	33.6	31.3	0.0649	38.7	29.4	0.0494	38.6	38.6	0.0534	29.9	27.0	171.9	157.4	0.24	0.11
43221	0.0611	31.0	31.0	0.0607	33.6	31.2	0.0650	38.7	29.4	0.0493	43.9	38.6	0.0532	27.1	27.1	174.3	157.4	0.24	0.11
43222	0.0611	31.0	31.0	0.0607	33.6	31.2	0.0650	38.7	29.4	0.0493	38.6	38.6	0.0532	27.1	27.1	169.0	157.4	0.24	0.11
43231	0.0568	33.3	33.3	0.0565	35.8	33.5	0.0602	41.2	31.5	0.0535	43.3	37.5	0.0665	39.8	23.1	193.3	158.7	0.24	0.11
43232	0.0568	33.3	33.3	0.0565	35.8	33.5	0.0602	41.2	31.5	0.0535	37.5	37.5	0.0665	39.8	23.1	187.5	158.7	0.24	0.11
43241	0.0604	31.4	31.4	0.0599	33.9	31.6	0.0641	39.1	29.7	0.0501	43.8	38.4	0.0555	308.2	26.1	456.3	157.2	0.24	0.11
43242	0.0604	31.4	31.4	0.0599	33.9	31.6	0.0641	39.1	29.7	0.0501	38.4	38.4	0.0555	308.2	26.1	450.9	157.2	0.24	0.11
43311	0.0622	30.5	30.5	0.0617	33.1	30.8	0.0617	33.1	30.8	0.0483	44.1	39.0	0.0544	29.5	26.6	170.3	157.6	0.24	0.11
43312	0.0622	30.5	30.5	0.0617	33.1	30.8	0.0617	33.1	30.8	0.0483	39.0	39.0	0.0544	29.5	26.6	165.2	157.6	0.24	0.11
43321	0.0623	30.5	30.5	0.0617	33.1	30.7	0.0617	33.1	30.7	0.0483	44.1	39.0	0.0542	26.7	26.7	167.5	157.7	0.24	0.11
43322	0.0623	30.5	30.5	0.0617	33.1	30.7	0.0617	33.1	30.7	0.0483	39.0	39.0	0.0542	26.7	26.7	162.4	157.7	0.24	0.11
43331	0.0577	32.8	32.8	0.0573	35.3	33.0	0.0573	35.3	33.0	0.0527	43.4	37.7	0.0677	39.1	22.8	185.8	159.2	0.24	0.11
43332	0.0577	32.8	32.8	0.0573	35.3	33.0	0.0573	35.3	33.0	0.0527	37.7	37.7	0.0677	39.1	22.8	180.1	159.2	0.24	0.11
43341	0.0615	30.9	30.9	0.0610	33.4	31.1	0.0610	33.4	31.1	0.0490	44.0	38.7	0.0565	307.7	25.7	449.4	157.5	0.24	0.11
43342	0.0615	30.9	30.9	0.0610	33.4	31.1	0.0610	33.4	31.1	0.0490	38.7	38.7	0.0565	307.7	25.7	444.2	157.5	0.24	0.11
43411	0.0621	30.6	30.6	0.0616	33.2	30.8	0.0621	30.6	30.6	0.0484	44.1	39.0	0.0543	29.5	26.6	167.9	157.6	0.24	0.11
43412	0.0621	30.6	30.6	0.0616	33.2	30.8	0.0621	30.6	30.6	0.0484	39.0	39.0	0.0543	29.5	26.6	162.8	157.6	0.24	0.11
43421	0.0621	30.6	30.6	0.0616	33.1	30.8	0.0621	30.6	30.6	0.0484	44.1	39.0	0.0541	26.7	26.7	165.1	157.6	0.24	0.11
43422	0.0621	30.6	30.6	0.0616	33.1	30.8	0.0621	30.6	30.6	0.0484	39.0	39.0	0.0541	26.7	26.7	160.0	157.6	0.24	0.11
43431	0.0576	32.8	32.8	0.0572	35.3	33.0	0.0576	32.8	32.8	0.0528	43.4	37.6	0.0676	39.2	22.9	183.5	159.2	0.24	0.11
43432	0.0576	32.8	32.8	0.0572	35.3	33.0	0.0576	32.8	32.8	0.0528	37.6	37.6	0.0676	39.2	22.9	177.8	159.2	0.24	0.11
43441	0.0613	30.9	30.9	0.0609	33.5	31.1	0.0613	30.9	30.9	0.0491	43.9	38.7	0.0564	307.8	25.8	447.0	157.4	0.24	0.11
43442	0.0613	30.9	30.9	0.0609	33.5	31.1	0.0613	30.9	30.9	0.0491	38.7	38.7	0.0564	307.8	25.8	441.8	157.4	0.24	0.11
44111	0.0621	30.6	30.6	0.0621	30.6	30.6	0.0614	36.0	30.9	0.0479	44.2	39.2	0.0544	29.5	26.6	170.8	157.8	0.24	0.11
44112	0.0621	30.6	30.6	0.0621	30.6	30.6	0.0614	36.0	30.9	0.0479	39.2	39.2	0.0544	29.5	26.6	165.8	157.8	0.24	0.11
44121	0.0622	30.5	30.5	0.0622	30.5	30.5	0.0615	36.0	30.8	0.0478	44.2	39.2	0.0541	26.7	26.7	168.0	157.8	0.24	0.11
44122	0.0622	30.5	30.5	0.0622	30.5	30.5	0.0615	36.0	30.8	0.0478	39.2	39.2	0.0541	26.7	26.7	163.0	157.8	0.24	0.11
44131	0.0577	32.8	32.8	0.0577	32.8	32.8	0.0569	38.3	33.2	0.0523	43.4	37.8	0.0677	39.1	22.8	186.3	159.3	0.24	0.11
44132	0.0577	32.8	32.8	0.0577	32.8	32.8	0.0569	38.3	33.2	0.0523	37.8	37.8	0.0677	39.1	22.8	180.7	159.3	0.24	0.11
44141	0.0614	30.9	30.9	0.0614	30.9	30.9	0.0607	36.3	31.2	0.0486	44.0	38.9	0.0565	307.7	25.8	449.9	157.6	0.24	0.11
44142	0.0614	30.9	30.9	0.0614	30.9	30.9	0.0607	36.3	31.2	0.0486	38.9	38.9	0.0565	307.7	25.8	444.7	157.6	0.24	0.11
44211	0.0610	31.1	31.1	0.0610	31.1	31.1	0.0648	38.8	29.5	0.0490	44.0	38.7	0.0533	30.0	27.1	174.9	157.5	0.24	0.11
44212	0.0610	31.1	31.1	0.0610	31.1	31.1	0.0648	38.8	29.5	0.0490	38.7	38.7	0.0533	30.0	27.1	169.6	157.5	0.24	0.11
44221	0.0610	31.1	31.1	0.0610	31.1	31.1	0.0648	38.7	29.5	0.0490	44.0	38.8	0.0531	27.2	27.2	172.0	157.5	0.24	0.11
44222	0.0610	31.1	31.1	0.0610	31.1	31.1	0.0648	38.7	29.5	0.0490	38.8	38.8	0.0531	27.2	27.2	166.8	157.5	0.24	0.11
44231	0.0568	33.3	33.3	0.0568	33.3	33.3	0.0601	41.2	31.5	0.0532	43.3	37.5	0.0664	39.9	23.1	191.0	158.7	0.24	0.11
44232	0.0568	33.3	33.3	0.0568	33.3	33.3	0.0601	41.2	31.5	0.0532	37.5	37.5	0.0664	39.9	23.1	185.2	158.7	0.24	0.11
44241	0.0603	31.4	31.4	0.0603	31.4	31.4	0.0640	39.1	29.8	0.0497	43.8	38.5	0.0554	308.2	26.2	454.0	157.3	0.24	0.11
44242	0.0603	31.4	31.4	0.0603	31.4	31.4	0.0640	39.1	29.8	0.0497	38.5	38.5	0.0554	308.2	26.2	448.7	157.3	0.24	0.11
44311	0.0621	30.6	30.6	0.0621	30.6	30.6	0.0616	33.2	30.8	0.0479	44.2	39.1	0.0543	29.5	26.6	168.0	157.8	0.24	0.11
44312	0.0621	30.6	30.6	0.0621	30.6	30.6	0.0616	33.2	30.8	0.0479	39.1	39.1	0.0543	29.5	26.6	163.0	157.8	0.24	0.11
44321	0.0621	30.6	30.6	0.0621	30.6	30.6	0.0616	33.1	30.8	0.0479	44.2	39.2	0.0541	26.7	26.7	165.2	157.8	0.24	0.11
44322	0.0621	30.6	30.6	0.0621	30.6	30.6	0.0616	33.1	30.8	0.0479	39.2	39.2	0.0541	26.7	26.7	160.1	157.8	0.24	0.11
44331	0.0576	32.8	32.8	0.0576	32.8	32.8	0.0572	35.3	33.0	0.0524	43.4	37.7	0.0676	39.2	22.9	183.6	159.2	0.24	0.11
44332	0.0576	32.8	32.8	0.0576	32.8	32.8	0.0572	35.3	33.0	0.0524	37.7	37.7	0.0676	39.2	22.9	177.9	159.2	0.24	0.11
44341	0.0613	30.9	30.9	0.0613	30.9	30.9	0.0609	33.5	31.1	0.0487	44.0	38.9	0.0564	307.8	25.8	447.1	157.6	0.24	0.11
44342	0.0613	30.9	30.9	0.0613	30.9	30.9	0.0609	33.5	31.1	0.0487	38.9	38.9	0.0564	307.8	25.8	441.9	157.6	0.24	0.11
44411	0.0619	30.7	30.7	0.0619	30.7	30.7	0.0619	30.7	30.7	0.0481	44.1	39.1	0.0542	29.6	26.7	165.7	157.7	0.24	0.11
44412	0.0619	30.7	30.7	0.0619	30.7	30.7	0.0619	30.7	30.7	0.0481	39.1	39.1	0.0542	29.6	26.7	160.6	157.7	0.24	0.11
44421	0.0620	30.6	30.6	0.0620	30.6	30.6	0.0620	30.6	30.6	0.0480	44.2	39.1	0.0539	26.8	26.8	162.8	157.7	0.24	0.11
44422	0.0620	30.6	30.6	0.0620	30.6	30.6	0.0620	30.6	30.6	0.0480	39.1	39.1	0.0539	26.8	26.8	157.7	157.7	0.24	0.11
44431	0.0575	32.9	32.9	0.0575	32.9	32.9	0.0575	32.9	32.9	0.0525	43.4	37.7	0.0674	39.3	22.9	181.3	159.2	0.24	0.11
44432	0.0575	32.9	32.9	0.0575	32.9	32.9	0.0575	32.9	32.9	0.0525	37.7	37.7	0.0674	39.3	22.9	175.6	159.2	0.24	0.11
44441	0.0612	31.0	31.0	0.0612	31.0	31.0	0.0612	31.0	31.0	0.0488	44.0	38.8	0.0563	307.8	25.8	444.7	157.6	0.24	0.11
44442	0.0612	31.0	31.0	0.0612	31.0	31.0	0.0612	31.0	31.0	0.0488	38.8	38.8	0.0563	307.8	25.8	439.5	157.6	0.24	0.11

Table B.1: Exhaustive search and bottom curve follower approach results

1-Process combinations;2-Alocated tolerance of X1 in LM;3-Toelrance cost of X1 in LM;4-Tolerance cost of X1 in BCF; 5-Alocated tolerance of X2 in LM;6-Toelrance cost of X2 in LM;7-Tolerance cost of X2 in BCF; 8-Alocated tolerance of X3 in LM;9-Toelrance cost of X3 in LM;10-Tolerance cost of X3 in BCF; 11-Alocated tolerance of X4 in LM;12-Toelrance cost of X4 in LM;13-Tolerance cost of X4 in BCF;14-Alocated tolerance of X5 in LM;15-Toelrance cost of X5 in LM;16-Tolerance cost of X5 in BCF;17-Total tolerance cost in LM;18-Total tolerance cost in BCF;19-t_{asm1};20-t_{asm2};

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