Appendix-D Part-I

Combining Part R and Part F of the Cutout scenario

Calculation Algorithm (1)

◆ prepare the

	A		
	$\boldsymbol{X_1}$	$\boldsymbol{X_2}$	$\boldsymbol{X_3}$
$\boldsymbol{Y_1}$	a_{11}	a_{12}	a_{13}
$\boldsymbol{Y_2}$	a_{21}	a_{22}	a_{23}
$\boldsymbol{Y_3}$	a_{31}	a_{32}	a_{33}

	B		
	$\boldsymbol{Y_1}$	$\boldsymbol{Y_2}$	$\boldsymbol{Y_3}$
$\boldsymbol{Z_1}$	b_{11}	b_{12}	b_{13}
$\boldsymbol{Z_2}$	b_{21}	b_{22}	b_{23}
$\boldsymbol{Z_3}$	b_{31}	b_{32}	b_{33}

$A$the variables X, Ycontain $B$the Y, Zprobabilities for . ($\Sigma\Sigma a_{ij} = 1, \Sigma\Sigma b_{ij} = 1$)
For example , the $X = X_1, Y = Y_1$probability $a_{11}$when .
From these two matrices, X, Zfind the

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calculation algorithm (2)

A

	X_1	X_2	X_3
Y_1	a_{11}	a_{12}	a_{13}
Y_2	a_{21}	a_{22}	a_{23}
Y_3	a_{31}	a_{32}	a_{33}

B

	Y_1	Y_2	Y_3
Z_1	b_{11}	b_{12}	b_{13}
Z_2	b_{21}	b_{22}	b_{23}
Z_3	b_{31}	b_{32}	b_{33}

As an example, $\Pr[X = X_1 \cap Z = Z_1]$*Ask for*

$X = X_1$from $(a_{11}, a_{21}, a_{31})$the matrix A.

Similarly, the probability of is $Z = Z_1$from $(b_{11}, b_{12}, b_{13})$the matrix B.

By the way , The variables $Y$are two matrices A, Bcommon to

Therefore, $Y = Y_1$when $\Pr[Y = Y_1 \cap X = X_1]$can be calculated $\Pr[Y = Y_1 \cap Z = Z_1]$simultaneously (assumed $X$to be Zindependent of)

Therefore , $\Pr[Y = Y_1 \cap X = X_1 \cap Z = Z_1] = a_{11} \times b_{11}$

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computational algorithm (3)

A

	X_1	X_2	X_3
Y_1	a_{11}	a_{12}	a_{13}
Y_2	a_{21}	a_{22}	a_{23}
Y_3	a_{31}	a_{32}	a_{33}

B

	Y_1	Y_2	Y_3
Z_1	b_{11}	b_{12}	b_{13}
Z_2	b_{21}	b_{22}	b_{23}
Z_3	b_{31}	b_{32}	b_{33}

By the way $X = X_1 \cap Z = Z_1$, $Y = Y_2$because sometimes

$$\Pr[Y = Y_2 \cap X = X_1 \cap Z = Z_1] = a_{21} \times b_{12}$$

Similarly, $Y = Y_3$when

$$\Pr[Y = Y_3 \cap X = X_1 \cap Z = Z_1] = a_{31} \times b_{13}$$

becomes.

Therefore , $\Pr[X = X_1 \cap Z = Z_1] = a_{11} \times b_{11} + a_{21} \times b_{12} + a_{31} \times b_{13}$is.

computational algorithm (4)

A

	X_1	X_2	X_3
Y_1	a_{11}	a_{12}	a_{13}
Y_2	a_{21}	a_{22}	a_{23}
Y_3	a_{31}	a_{32}	a_{33}

B

	Y_1	Y_2	Y_3
Z_1	b_{11}	b_{12}	b_{13}
Z_2	b_{21}	b_{22}	b_{23}
Z_3	b_{31}	b_{32}	b_{33}

$c_{11} = \mathrm{Pr}[X = X_1 \cap Z = Z_1] = a_{11} \times b_{11} + a_{21} \times b_{12} + a_{31} \times b_{13}$ **and Calculating this for all cases gives the**

Note that this calculation $C = BA$ is

C

	X_1	X_2	X_3
Z_1	c_{11}		
Z_2			
Z_3			

Calculated target

- All data for both parts R and F (no distinction between low speed and high speed regions)
  - Part R: N=50763
  - Part F: N=4114
- Part R calculates
- normalization range is as follows
  - Part R own vehicle speed: 0-150[km/h], other vehicle speed: 0-150[km/h]
  - Part F other vehicle speed: 0-150[km/h], preceding vehicle speed: 0-120[km/h]
- number of divisions is as follows
  - Part R: 10 divisions Part F: 5 divisions

- All data for parts R and F (no distinction between low speed and high speed range)

Part R: N = 50763 Part F: N = 4114

- Part R calculates the combined distribution (probability) for the subject vehicle speed [km/h] and cut-out vehicle speed [km/h], and Part F calculates the combined distribution (probability) for the cut-out vehicle speed [km/h] and the preceding vehicle speed [km/h].
- The normalization range is as follows: Part R subject vehicle speed: 0-150 [km/h], cut-out vehicle speed: 0-150 [km/h]; Part F cut-out vehicle speed: 0-150 [km/h], preceding vehicle speed: 0-120 [km/h]
- The number of divisions is as follows: Part R: 10 splits Part F: 5 splits

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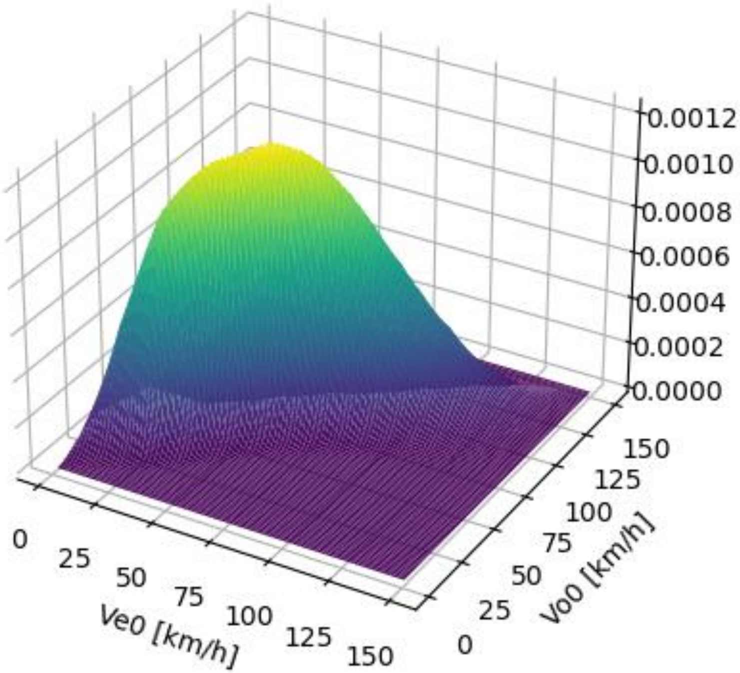
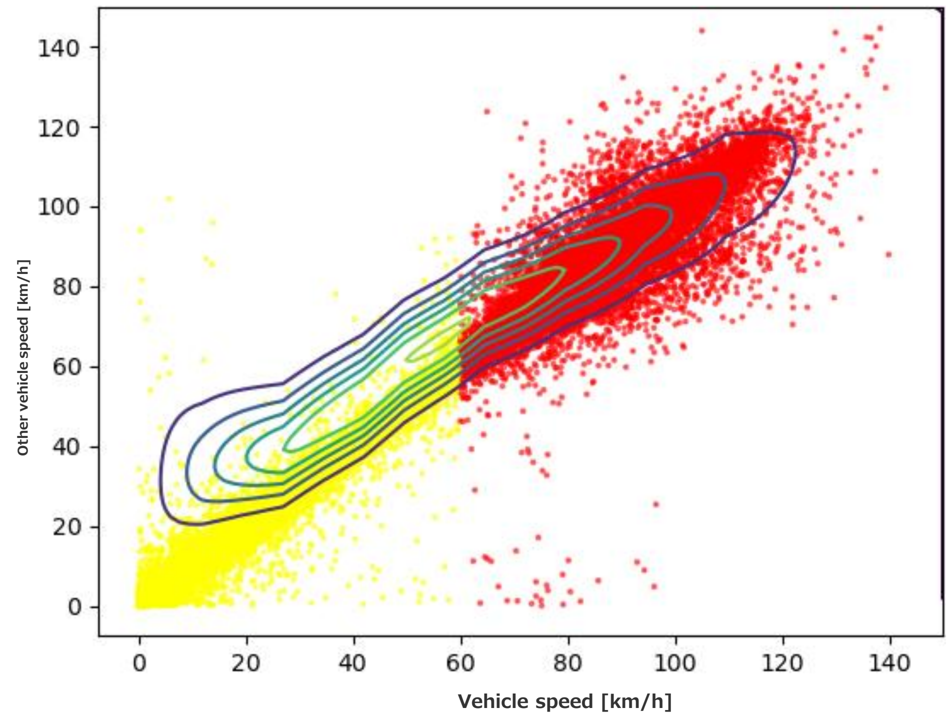
Part R

◆ Part R are shown below.





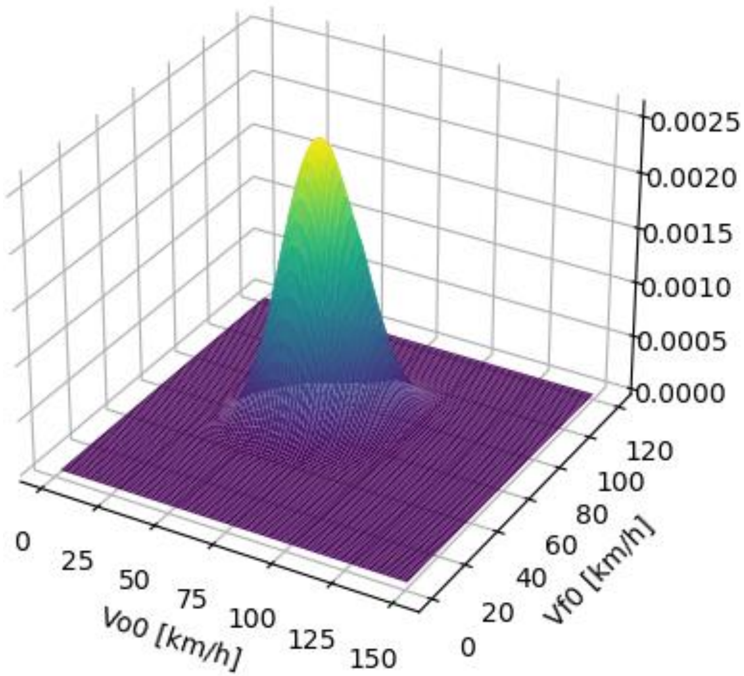
There is a proportional relationship between the own vehicle speed and the other vehicle speed.

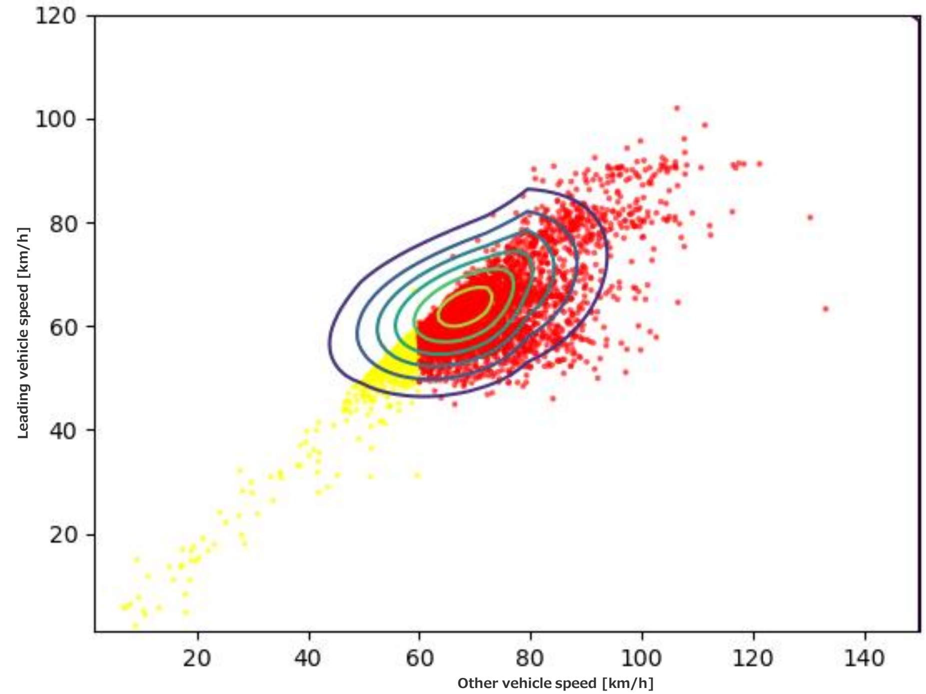
The probability peaks around

- There is a relationship such that the speed of the subject vehicle and the speed of the cut-out vehicle are proportional .
- The probability that the subject vehicle speed and cut-out vehicle speed are around 60 [km / h] is the peak.

Part F

◆ **Part F are shown below.**



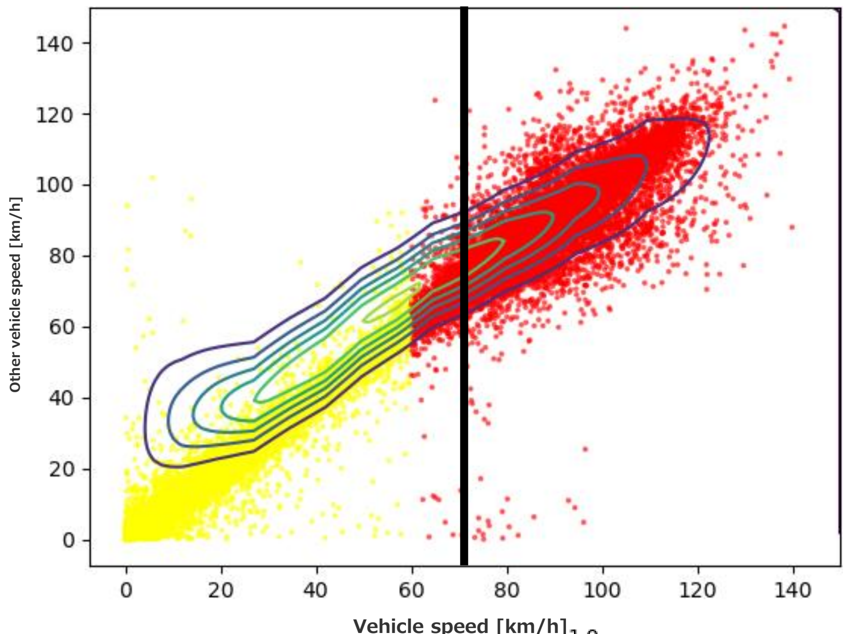


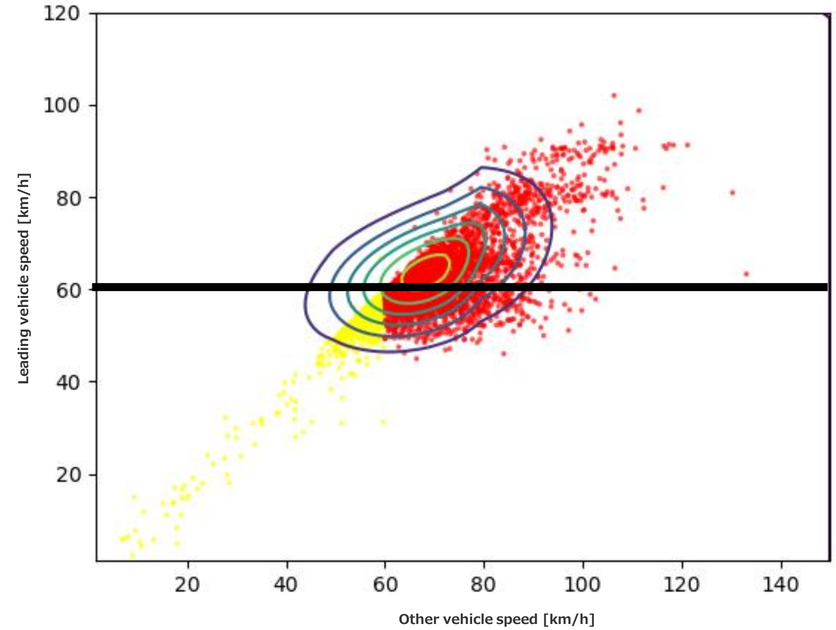
is a proportional relationship between the

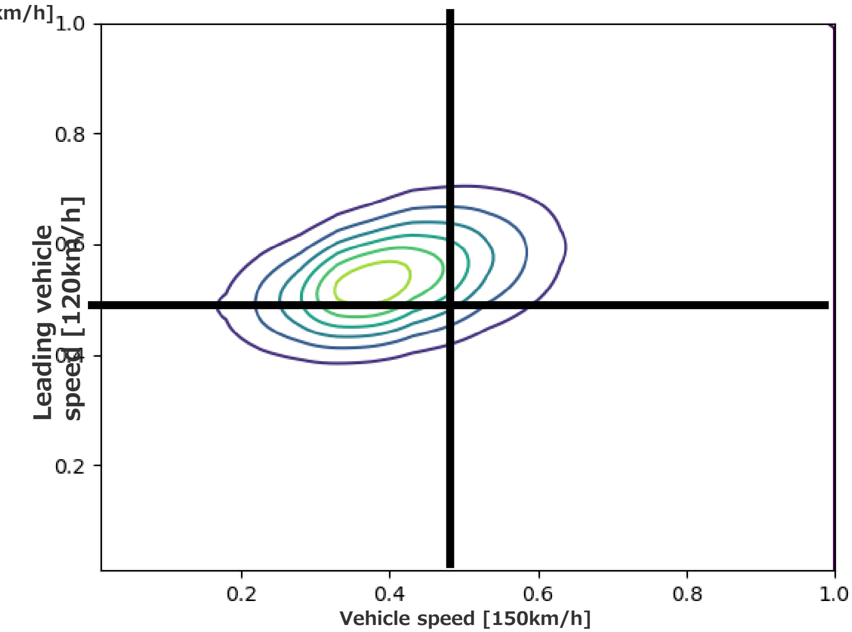
The probability peaks when the

- **There is a relationship such that the speed of cut-out vehicle and the speed of the preceding vehicle are proportional .**
- **Cut-out peak density occurred when cut-out vehicle speed and preceding vehicle speed are around 70 (km/h).**

Part R + F (contour diagram)







vehicle speed , The probability of 60 [km/h] and the preceding vehicle speed of 70 [km/h] peaks.

The peak density occurs when the subject vehicle speed is 60 (km/h) and the preceding vehicle speed is around 70 (km/h) is the peak.

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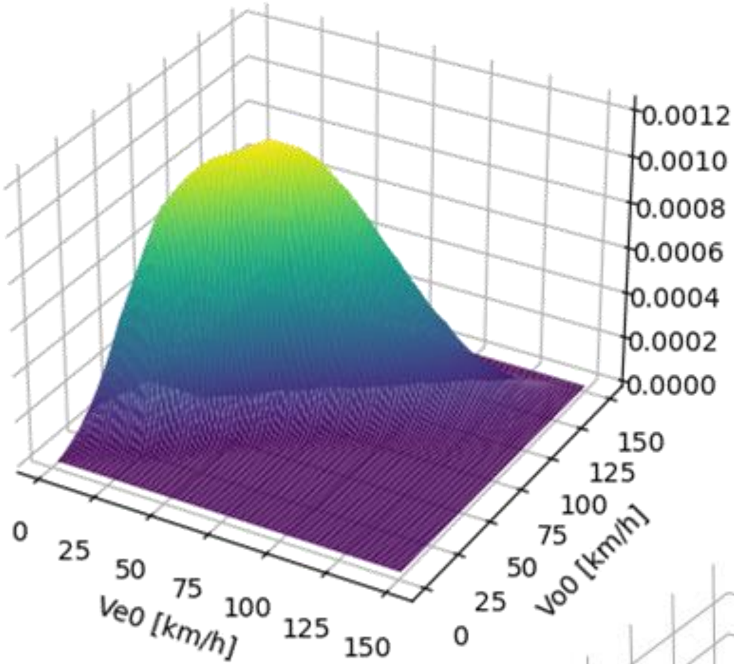
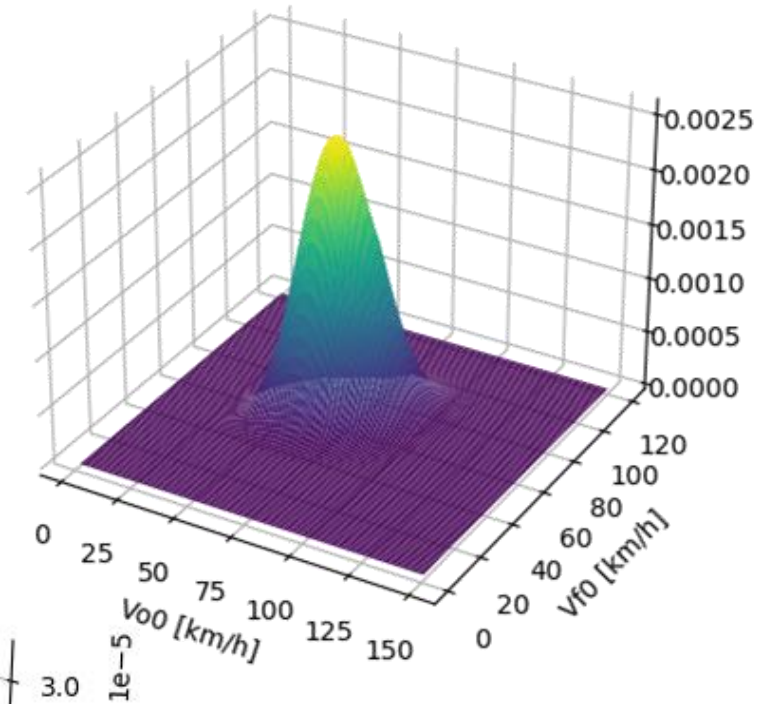
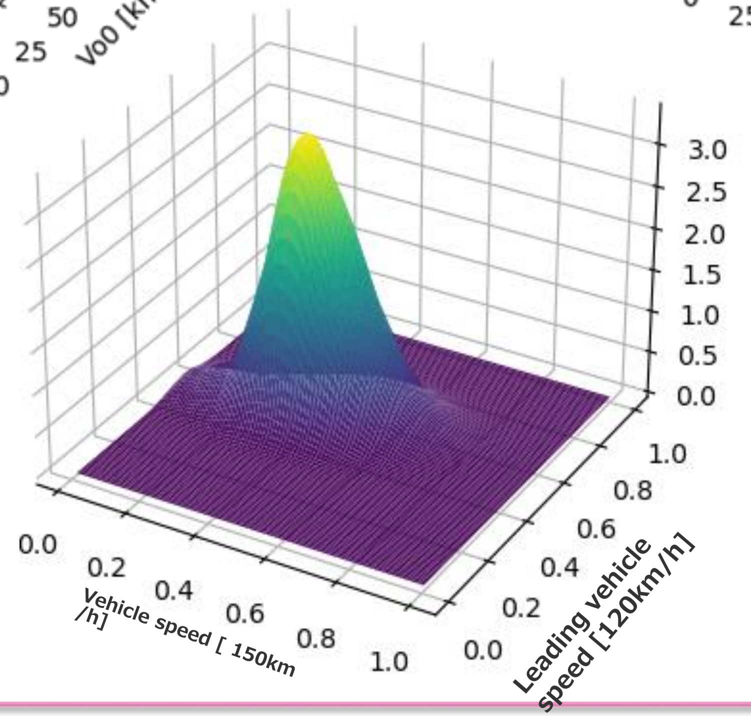
Part R+F (3D view)







vehicle speed , The probability of 60 [km/h] and the preceding vehicle speed of 70 [km/h] peaks.

The sum (probability) of the composite distribution is not

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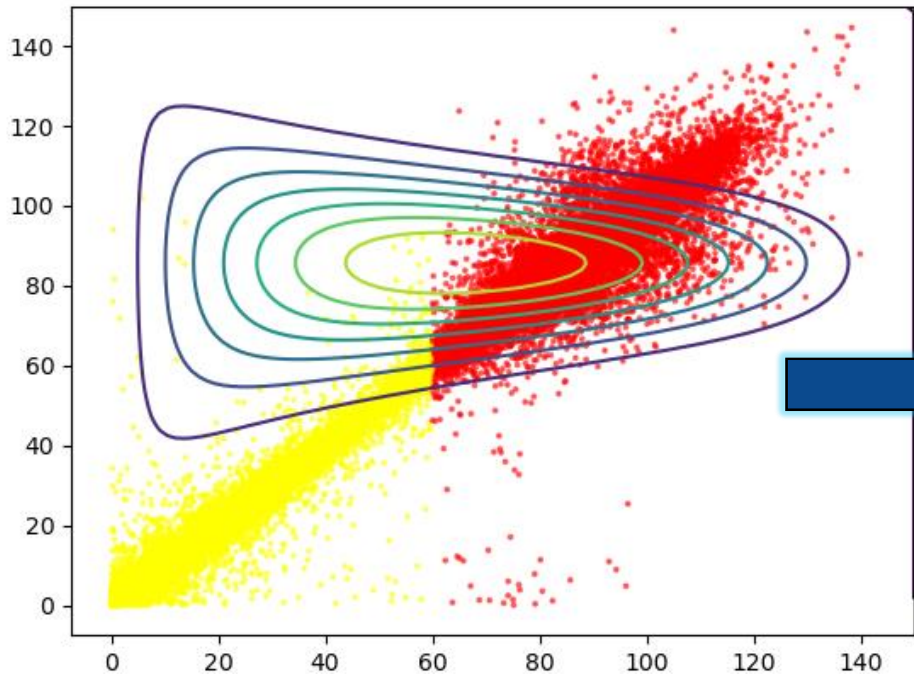
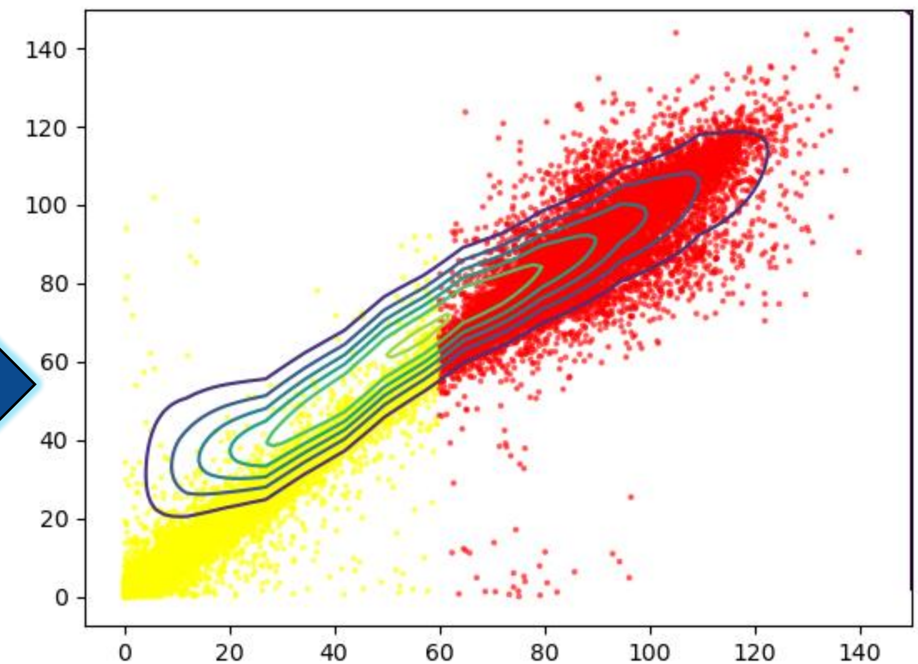
Improvement of synthetic distribution estimation algorithm

- when the correlation between the two parameters used to calculate the composite distribution is high, the calculation result of the composite distribution does not match the actual situation (scatter diagram) .
- Therefore, we improved the estimation algorithm and developed a method that can obtain results close to the actual situation even if the parameters



Calculation result by conventional method
Number of divisions : 5



Calculation result by improved method
Number of divisions : 10

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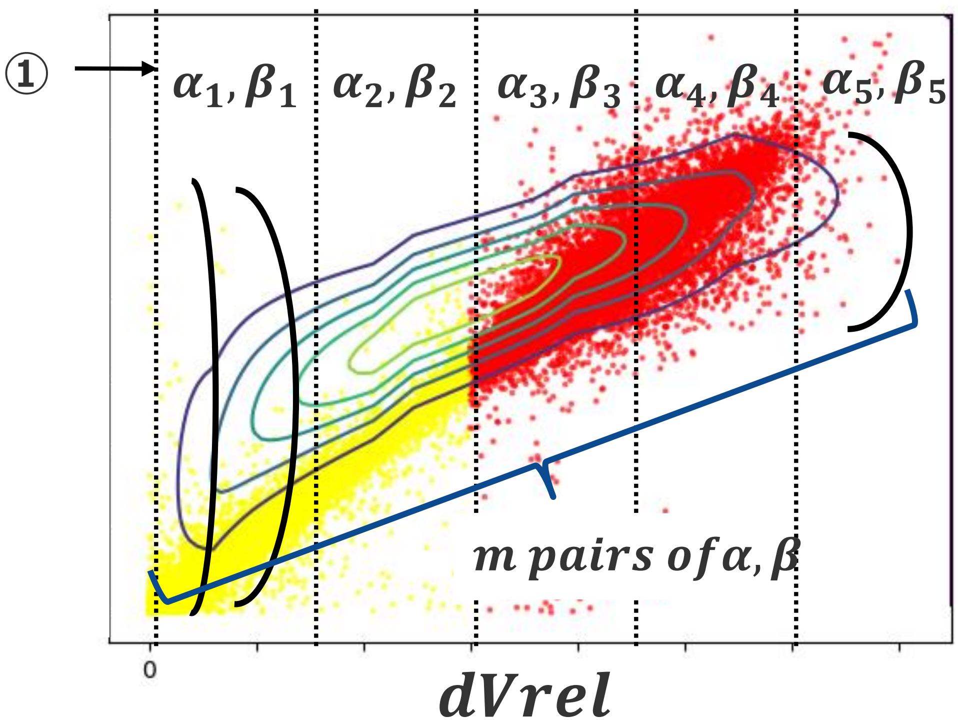
estimation algorithm

- Basically the same as the conventional method
- 1) Estimate for each divided α_n, β_n(*This time from the example of* 5 *division*, $n = 1, \dots, 5$) interval , (2) Regression was performed using the values of $\alpha_m, \beta_m (m = 1, \dots, 100)$α and β in adjacent intervals, and (3) after all α and β values were obtained, a moving average was obtained to reduce the difference for each interval.



$$\boxed{\begin{matrix} a_1 \\ a_2 \\ \\ a_5 \end{matrix}} \begin{matrix} = f(\alpha_1, \alpha_2) \\ = f(\alpha_2, \alpha_3) \\ \cdots \\ = f(\alpha_5, \alpha_6) \end{matrix} \qquad \boxed{\begin{matrix} b_1 \\ b_2 \\ \\ b_5 \end{matrix}} \begin{matrix} = g(\beta_1, \beta_2) \\ = g(\beta_2, \beta_3) \\ \cdots \\ = g(\beta_5, \beta_6) \end{matrix}$$

$\alpha_m = a_n * dVrel_n + 1 \quad \beta_m = b_n * dVrel_n + 1$ ②

a_nと$b_n$is the regression coefficient for each interval
dVrel is 100 values of 0.01,…,1
(this time divided into 5 from smaller n=5)

* If there is no adjacent interval (this time α_6, β_6) or if the adjacent interval $\alpha_n, \beta_n$is NaN , $b_{n-1,n}$use

$$\alpha'_m = h(\alpha_m) \quad \beta'_m = h(\beta_m)$$ ③

※h is the function for calculating the mean moving
※ ※α_m, β_mAll values receive correction

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