Y. Okamoto; 2004.2

# Confidence Interval for d'

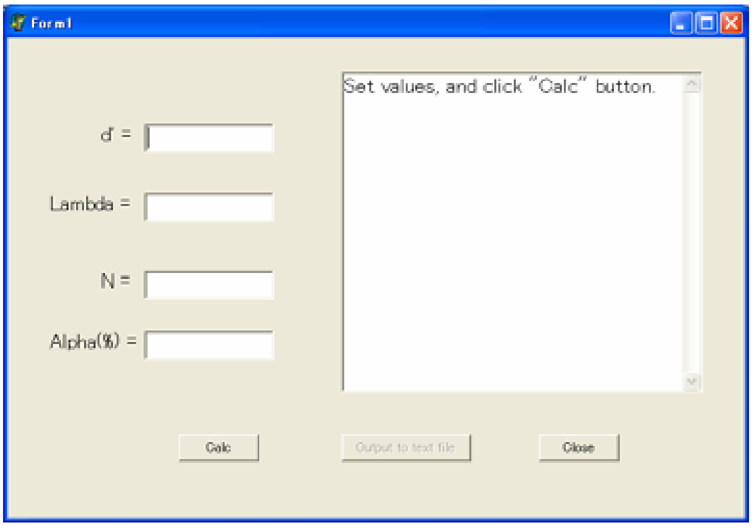


Figure 1　The form shown when the program starts.

Program PIntEstD.exe estimates confidence interval for $d'$ by eq. 11.9 in Wickens (2002). $se(d')$ is estimated not by eq. 11.8, but by eq. 11.5. Eq. 11.8 is the special case of eq. 11.5, where criterion is set to be optimal

$$\lambda = \frac{d'}{2} \tag{1}$$

In example 11.2 of Wickens (2002), estimation of $se(d')$ is made by eq. 11.8, which is derived using eq. 1. But, in example 11.3, $se(d')$ is estimated by eq. 11.5. If, in example 11.3, estimation were made by eq. 11.8 with criterion eq. 1, we would have

$$se(d') = 0.18581$$

This value is different from the one given in example 11.3, i.e.

$$se(d') = 0.193 \tag{2}$$

The value of eq. 2 can be obtained by eq. 11.5 with the criterion $\lambda = 0.100$ used in

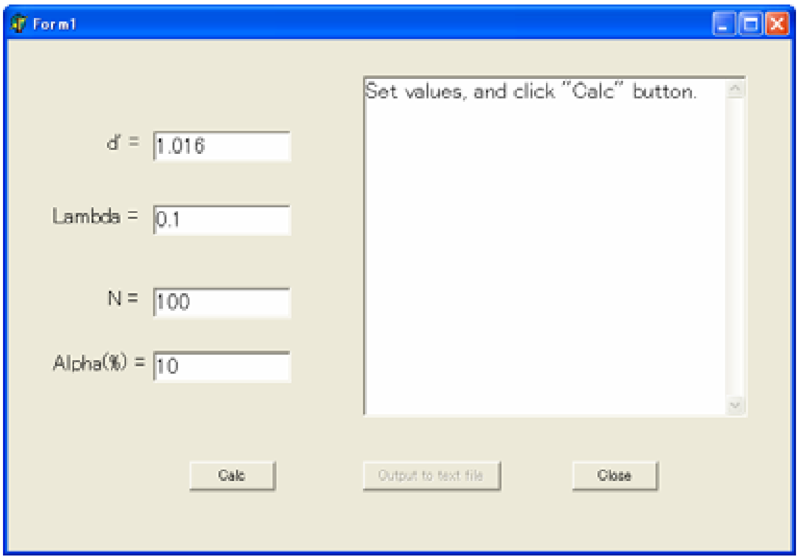


Figure 2　A form with values set.

example 11.1.

When PIntEstD.exe started, the form shown in Fig. 1 appears. Set values as in Figure 2.

In Fig. 2, the following values are set.

$$d' = 1.016$$
$$\lambda = 0.100$$
$$N = N_s = N_n = 100$$
$$\alpha = 10\% = 0.1$$

These are the values in examples 11.1 and 11.3.

After setting the values, click Calc button. Then calculation begins and results are displayed in the memo component (Fig. 3). Confidence intervals are displayed for each step of iteration. The confidence interval of the 1st step (the initial estimation)

0.6987 < d' < 1.3333

is equal to the one of example 11.3 (Wickens, 2002)

$$0.70 \le d' \le 1.33$$

within the significant figures.

Estimation of confidence interval are repeated according to the algorithm explained in Wickens (2002)[1], and each estimation of iteration is displayed in the memo component. This iteration is repeated until estimation converges. In Figure 3, the result after convergence is shown as the final result.

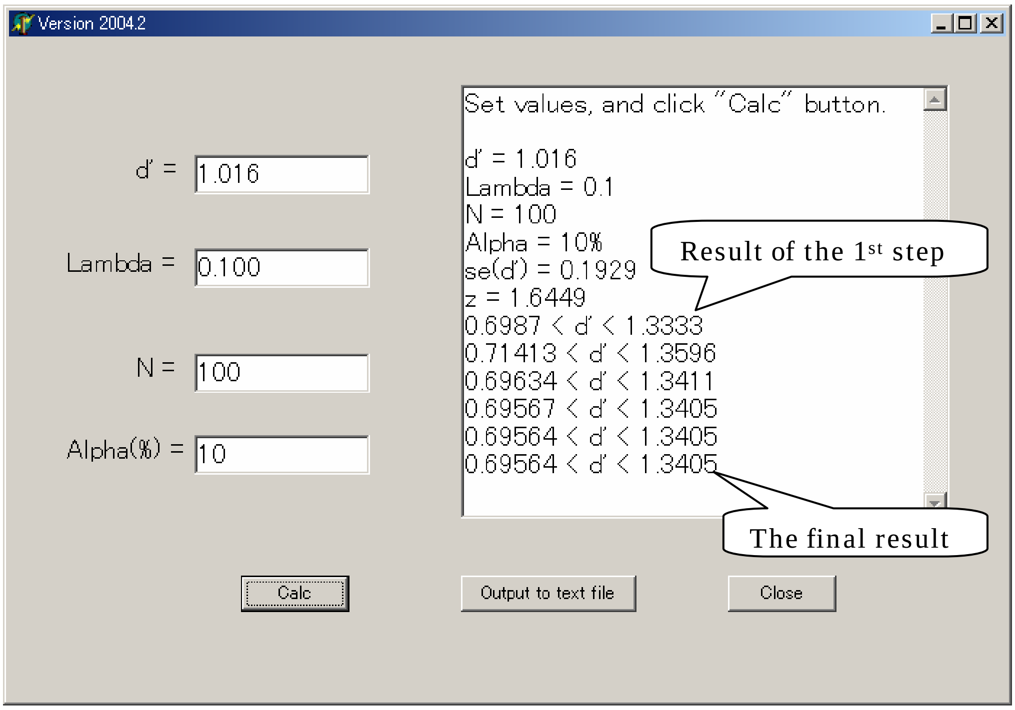


Figure 3 Result of calculation.

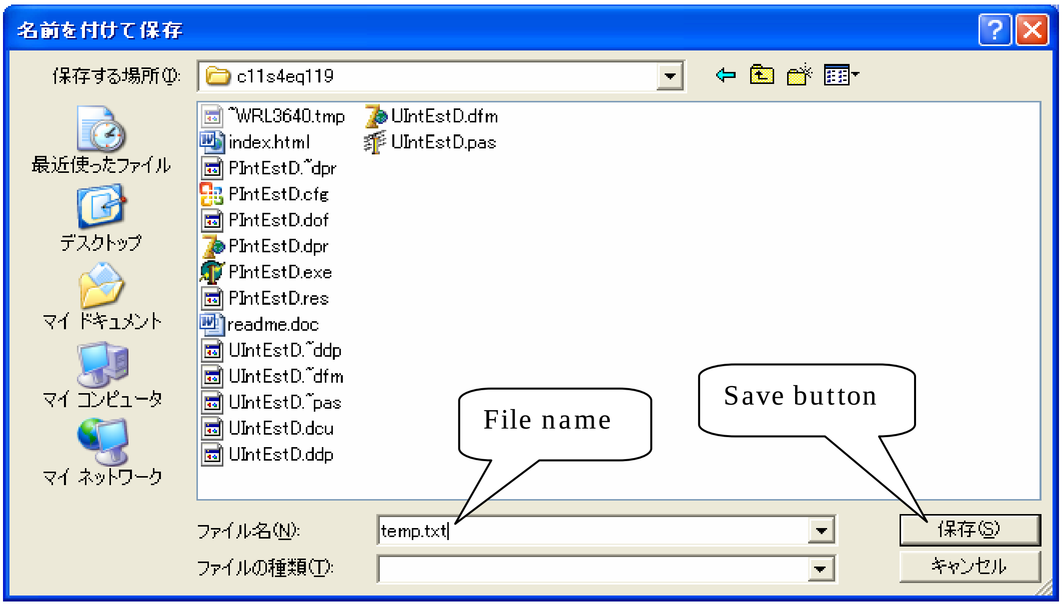


Figure 4 Save Dialog Box

1 See the appendix for the algorithm used, which is based on more detailed suggestion given by Wickens (2004.2) in personal communication.

The results shown in the memo component can be output to a text file by clicking "Output to text file" button. When you click "Output to text file" button, a save dialog box (Fig. 4) appears. In this dialog box, set any file name of text file, then click Save button. The text in the memo will be saved in a text file of the given name.

# Appendix

Wickens (personal communication, 2004.2) suggests that in iteration, the likelihood ratio should be held, while $\lambda$ are adjusted for the values of $d'$ at the end points in each iteration. So, I used the following algorithm in my program:

(1) Estimate the initial interval as explained in Wickens' book. Let it be

$$d_L \le d' \le d_U$$

(2) Estimate $\log\beta$ from the given data value.

(3) Calculate $\lambda_L$ and $\lambda_U$ for $d_L$ and $d_U$ as follows

$$\lambda_L = \frac{\log\beta}{d_L} + \frac{1}{2}d_L$$

$$\lambda_U = \frac{\log\beta}{d_U} + \frac{1}{2}d_U$$

(5) By eq. 11.5 in Wickens' book, estimate variances of $d'$s at the endpoints and corresponding new endpoints as follows;

$$V_L = \frac{\mathrm{var}(f_L)}{\varphi^2(\lambda_L)} + \frac{\mathrm{var}(h_L)}{\varphi^2(d_L - \lambda_L)}, \quad f_L = 1 - \Phi(\lambda_L), \ h_L = 1 - \Phi(\lambda_L - d_L)$$

$$V_U = \frac{\mathrm{var}(f_U)}{\varphi^2(\lambda_U)} + \frac{\mathrm{var}(h_U)}{\varphi^2(d_U - \lambda_U)}, \quad f_U = 1 - \Phi(\lambda_U), \ h_U = 1 - \Phi(\lambda_U - d_U)$$

$$d_{L1} = d' - z_{\alpha/2}\sqrt{V_L}$$

$$d_{U1} = d' + z_{\alpha/2}\sqrt{V_U}$$

(4) If $d_{L1}$ and $d_{U1}$ converges to $d_L$ and $d_U$ respectively, then quit this iteration.

(5) Put

$$d_L = d_{L1} \text{ and } d_U = d_{U1},$$

and go back to step (3)