STOCK ASSESSMENT FOR ALL
MENU-DRIVEN SOFTWARE DEVELOPMENT TEAM

Menu-driven software series (No. 1)

CPUE_Manager (ver1.3.6) (2025) Manual

May, 2025

Tom NISHIDA (PhD) (Representative)
aco20320@par.odn.ne.jp
Kazuharu Iwasaki (Software Engineer)
[MENU] © Menu-driven stock assessment software developing team(Japan)
https://www.esl.co.jp/products/menu

*Note: The current version is 1.3.6. Some software images in this Manual are from older versions,
But this is not a problem as they are the same.*

ACRONYMS

ANOVA	Analysis of variance
ASPIC	A Stock-Production Model Incorporating Covariates
ASPM	Age-Structured Production Model
B	Total biomass or Spawning Stock Biomass
B_{MSY}	Total biomass or Spawning Stock Biomass at MSY
CI	Confidence Interval
CPUE	Catch Per Unit Effort
EST	Estimated
F	Fishing mortality
F_{MSY}	Fishing mortality at MSY
GLM	General Linear Model or Generalized Linear Model
GPS	Global Positioning System
ICCAT	International Commission for the Conservation of Atlantic Tunas
IOTC	Indian Ocean Tuna Commission
JABBA	Just Another Bayesian Biomass Assessment
LRP	Limit Reference Point
MCMC	Markov Chain Monte Carlo methods
MSY	Maximum Sustainable Yield
OBS	Observed
QC	Quality Control
RFMO	Regional Fisheries Management Organization
SA	Stock assessment
SAS	Statistical Analysis System
SB or SSB	Spawning Biomass or Spawning Stock Biomass
SB_{MSY} or SSB_{MSY}	Spawning Biomass or Spawning Stock Biomass at MSY
SPSS	Statistical Package for the Social Sciences
SRA	Stock Reduction Analysis
SS3	Stock Synthesis 3
TB	Total Biomass
TB_{MSY}	Total Biomass at MSY
TRP	Target Reference Point
Y/R	Yield per Recruit

Acknowledgements

We thank Dr. Hiroki Yokoi (stock assessment expert, Japan Fisheries Research and Education Agency) for providing the R codes underlying this software. We are grateful to Professor Hiroshi Shono (eminent CPUE standardization expert, Mukogawa Women's University, Japan) for supportive technical advice.

SOFTWARE COPYRIGHT AND TERMS OF USE

- We are happy for everyone to use this software for your important work in fisheries managements.

- As we have many users, we have basic rules for users to utilize our software in a harmonious and trustworthy way.

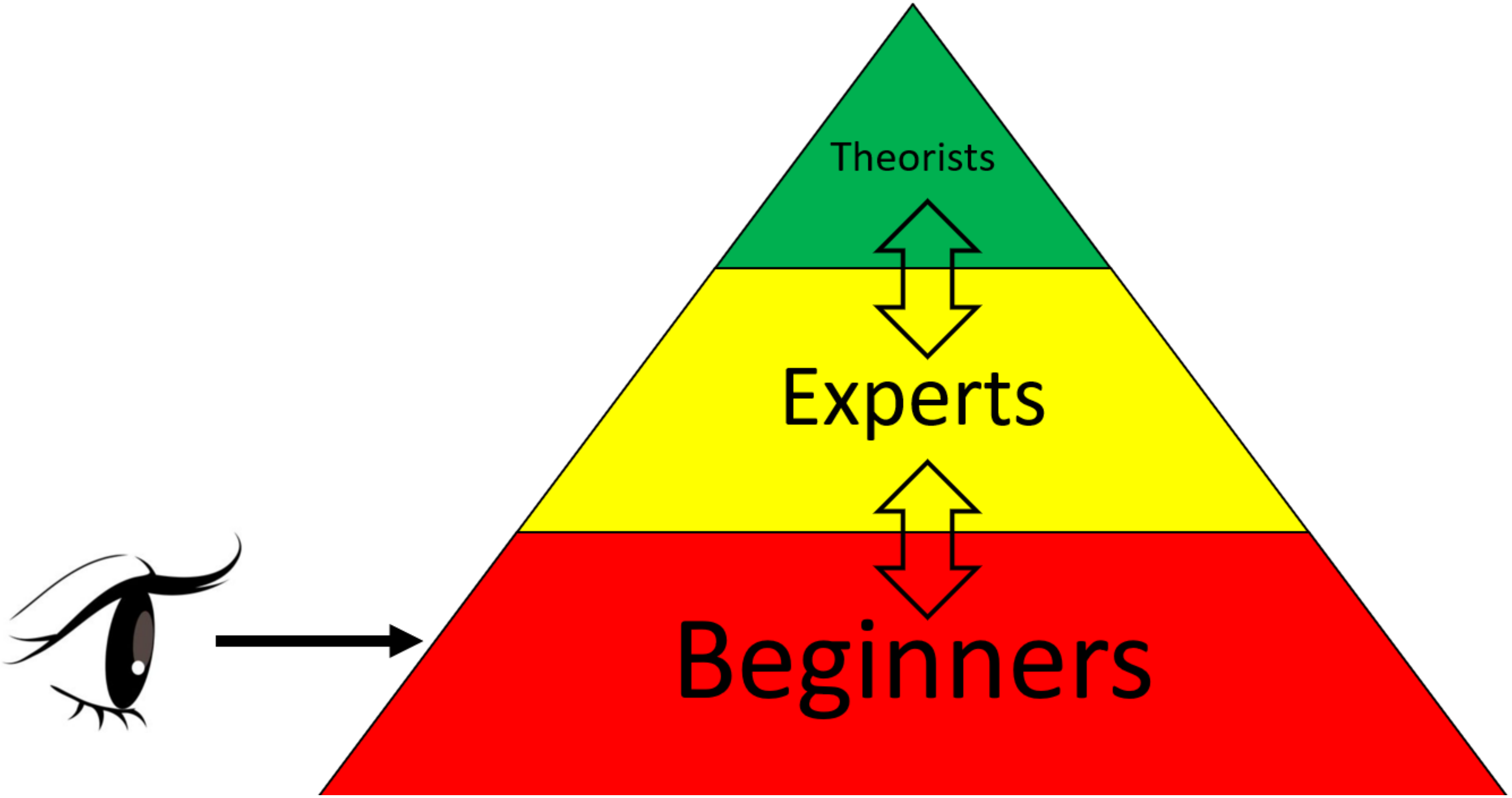
- Thus, we maintain the current **SOFTWARE COPYRIGHT & TERMS OF USE.** See page 5~8 at https://www.esl.co.jp/products/menu/menu.pdf

- Please kindly follow rules.

Contents

1. About

This menu-driven software (CPUE_Manager) is for beginners and also for those who cannot manipulate R underpinning this software. Therefore, this manual uses with less mathematical, statistical formulas & notations and no R commands.



1. About

The CPUE_Manager contains 3 main menus

(1) Quality control

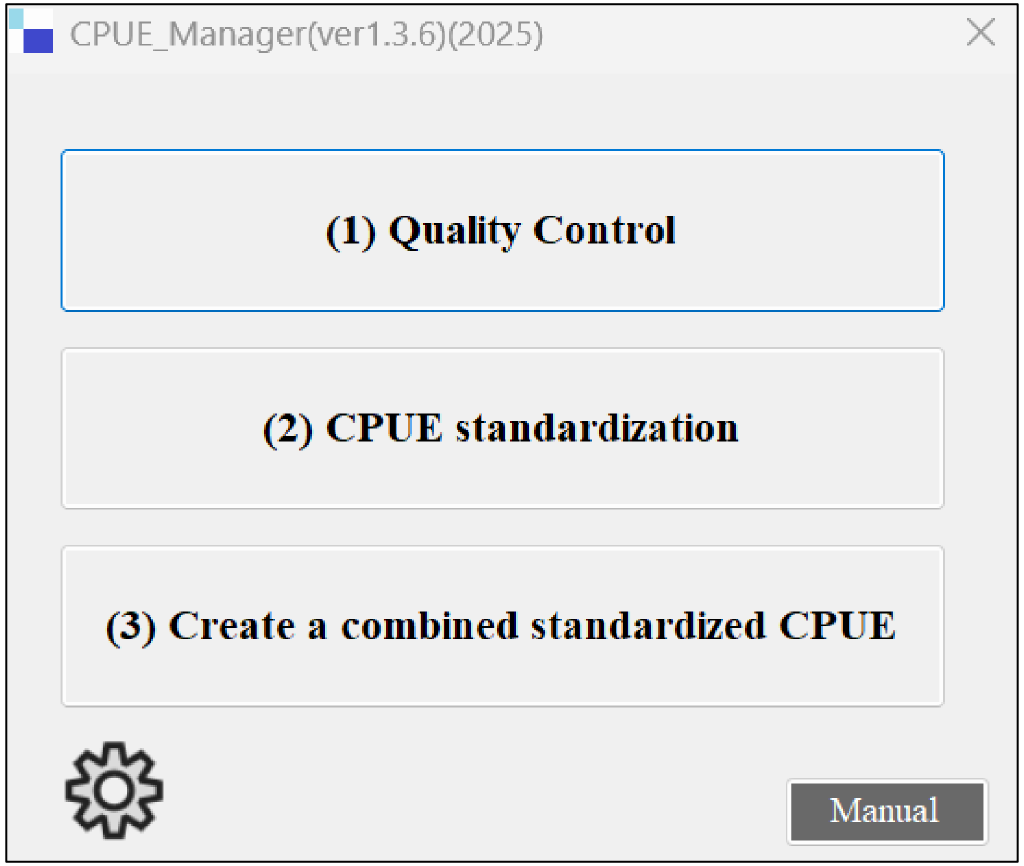
To check the relationship between catch vs. CPUE & detect outliers.

(2) CPUE Standardization

To generate unbiased nominal CPUE

(3) Create a combined & average CPUE

To produce a combined & average CPUE from 2 or more CPUE using weighted average by catch.



Remarks:
Menu (1) & (3) are mainly used for ASPIC preparation.
For JAABB, these 2 menus are not needed because JABBA has these functions inside.

2. REQUIREMENTS FOR PC AND IMPORTANT REMARKS (1/3)

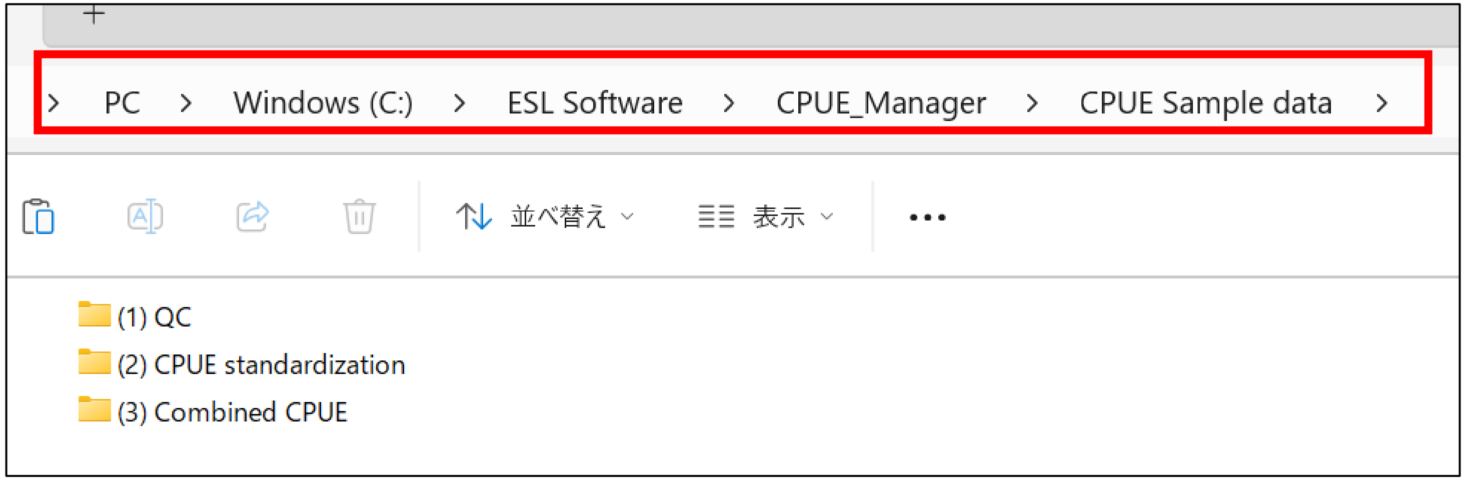
(1) Requirements for PC

- Screen resolution: 800x700 pixels or higher.
- If the menu & sub-menus do not fit within the screen, set the display setting in Windows to 100%.
- Operation System: MS window 10 or 11 (OS should be updated).
- **NOT applicable for MAC (apple) PC.**
- 64bit PC.
- RAM: minimum 2GB.
- Basic software (Word, Excel and Notepad)
- To make smooth operations, users need at least 30% of empty space of the hard disk.

2. REQUIREMENTS FOR PC AND IMPORTANT REMARKS (2/3)

(2) Important remarks (CPUE sample data)

This manual uses the sample excel data for demos in the folders (below)



> PC > Windows (C:) > ESL Software > CPUE_Manager > CPUE Sample data >

(1) QC
(2) CPUE standardization
(3) Combined CPUE

Users can use the sample data for practice

In the past, albeit rare, excel files could not be read

under windows driven by Indonesia & Malaysia languages.

In such case, change to the English window and make the same data by your PC.

2. REQUIREMENTS FOR PC AND IMPORTANT REMARKS (3/3)

(3) Other Important remarks

- **Manual**

  This PowerPoint is the manual. Manul call button is available.
- **Keep the original files** (important)

  Don’t use original files. Make copies & use copies as work files like wk1, wk2, etc.
- **Operation by mouse**

  Manual explains operations based on “mouse”.

  For “touch panel” or “key board”, follow corresponding manipulations.
- **Save**

  Save files frequently.
- **Engines (programs and applications) underpinning this software**

  Microsoft Visual Studio (2019)

  Graphics: C# and. NetFrameWork4.7.2

  R-4.4.1-win (2024)

3. Installation: CPUE_Manager
Internet environment

- Use fiber optic internet
- Do not use a proxy internet (proxy server)
  - ➔ Sometimes its security system is too strong to install.
  - ➔ This was experienced in Sri Lanka

3. Installation (2 application)

Before installation, uninstall old versions

(1) CPUE_Manager

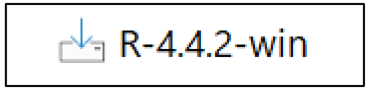
Please get the installation link from the [MENU] Secretariat at menu.soft.SEC@gmail.com

(2) If users currently use R-4.4.1, please continue to use.

If users don't have R-4.4.1, please Install R-4.4.2-win

(83MB, zipped)(187MB: unzipped) from

Download R-4.4.2 for Windows

Users will get the installer (zip file)  R-4.4.2-win then unzip & install.

What is R?

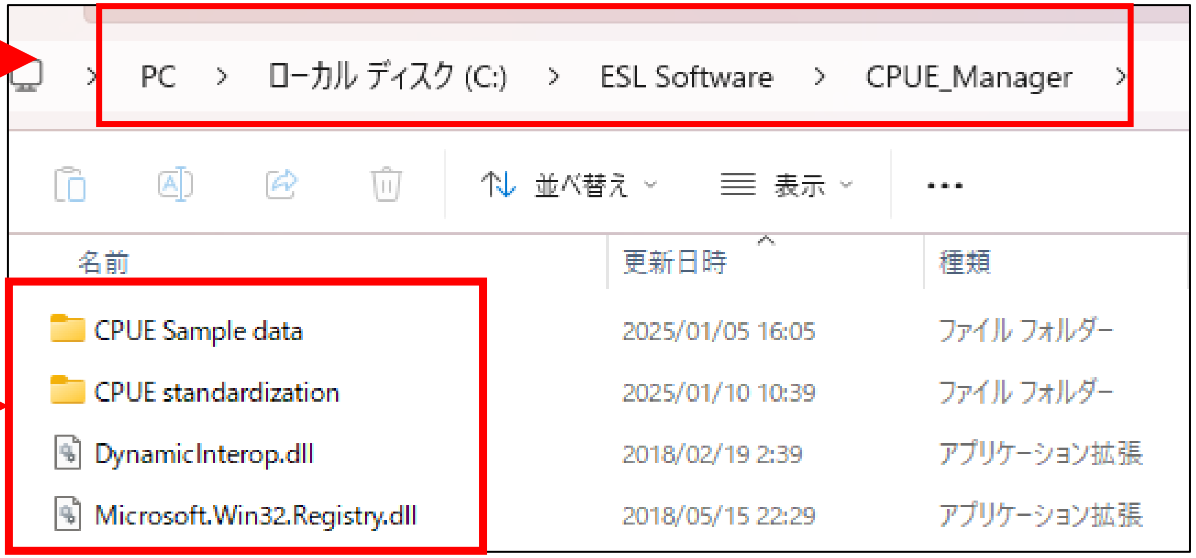
"R" is an open-source and free programming language that is widely used as a statistical software, data analysis and graphic tool.

Uninstallation of previous CPUE_Manager software

(1) When users need to uninstall the CPUE_Manager software, apply the normal procedures using the Window un-installment functions.

(2) However, sometimes, not all folders nor files are uninstalled and left the original folders.

(3) To delete them completely, go to the ESL software folder (normally) in C: drive). Then delete them manually.



PC > ローカル ディスク (C:) > ESL Software > CPUE_Manager >

名前	更新日時	種類
CPUE Sample data	2025/01/05 16:05	ファイル フォルダー
CPUE standardization	2025/01/10 10:39	ファイル フォルダー
DynamicInterop.dll	2018/02/19 2:39	アプリケーション拡張
Microsoft.Win32.Registry.dll	2018/05/15 22:29	アプリケーション拡張

ESL software folder

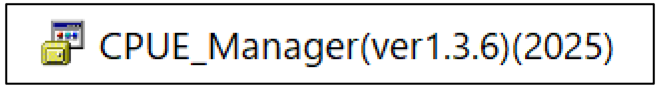
NOT completely un-installed (left-over) folders & files. Delete manually.

3. Installation: CPUE_Manager (Ver1.3.6)(2025)

Double click the zipped installer

(located folder or desktop)

Installer (folder)

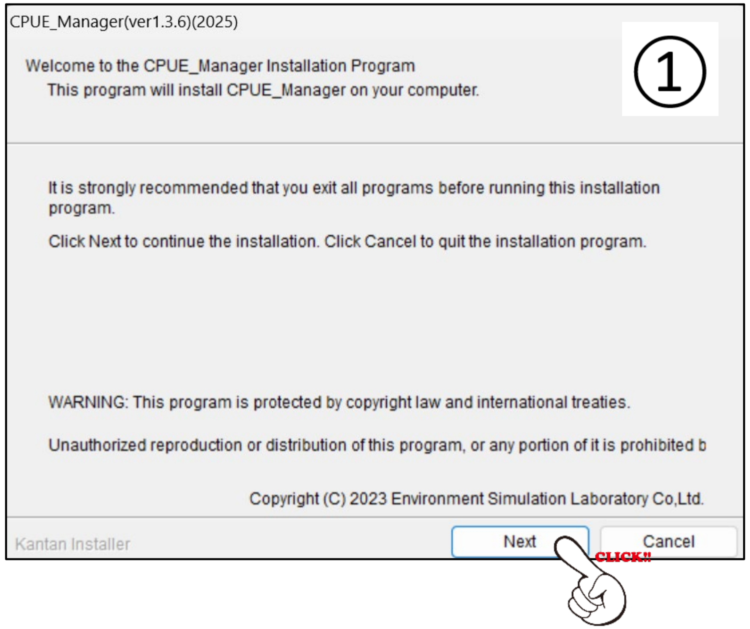


CPUE_Manager(ver1.3.6)(2025)

Installer (desktop)

CPUE_Manager

3. Installation_CPUE_Manager: 4 steps



CPUE_Manager(ver1.3.6)(2025)

Welcome to the CPUE_Manager Installation Program
This program will install CPUE_Manager on your computer.

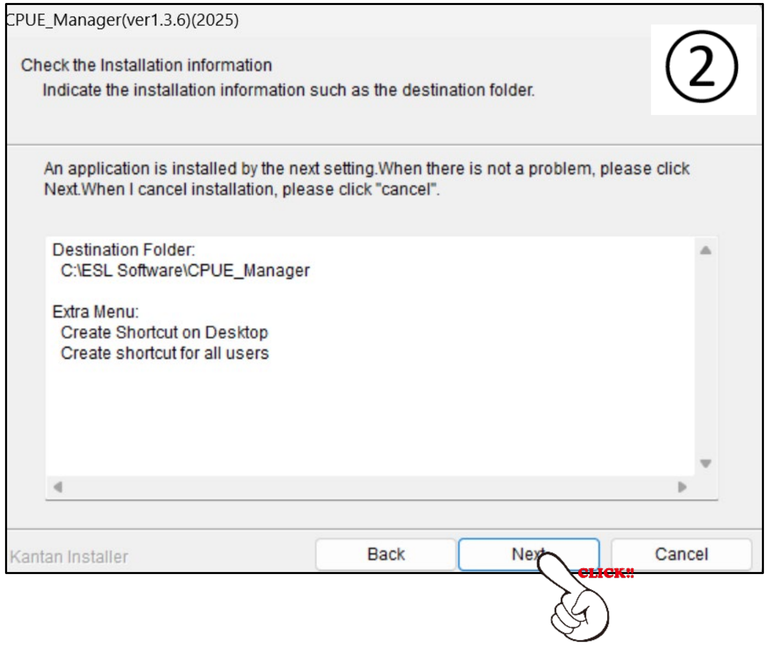
It is strongly recommended that you exit all programs before running this installation program.

Click Next to continue the installation. Click Cancel to quit the installation program.

WARNING: This program is protected by copyright law and international treaties.

Unauthorized reproduction or distribution of this program, or any portion of it is prohibited b

Copyright (C) 2023 Environment Simulation Laboratory Co,Ltd.



CPUE_Manager(ver1.3.6)(2025)

Check the Installation information
Indicate the installation information such as the destination folder.

An application is installed by the next setting.When there is not a problem, please click Next.When I cancel installation, please click "cancel".

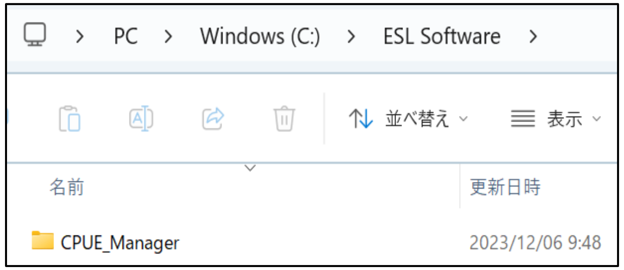
Destination Folder:
C:\ESL Software\CPUE_Manager

Extra Menu:
Create Shortcut on Desktop
Create shortcut for all users

情報

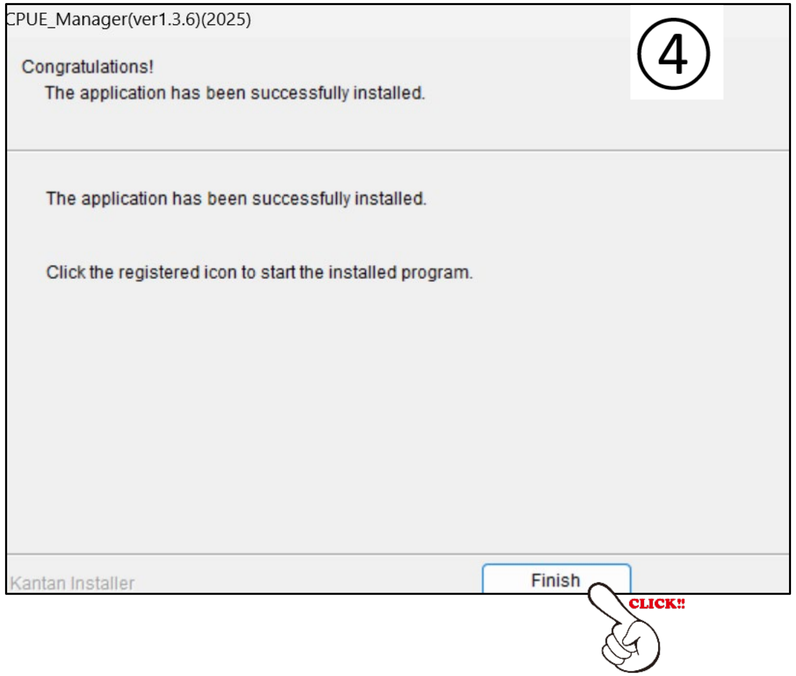
The destination folder does not exist. Do you want to create it?

If destination folder “ESL software” exits, this window will not appear.



CPUE_Manager 2023/12/06 9:48

Users will get
the CPUE_Manager folder.



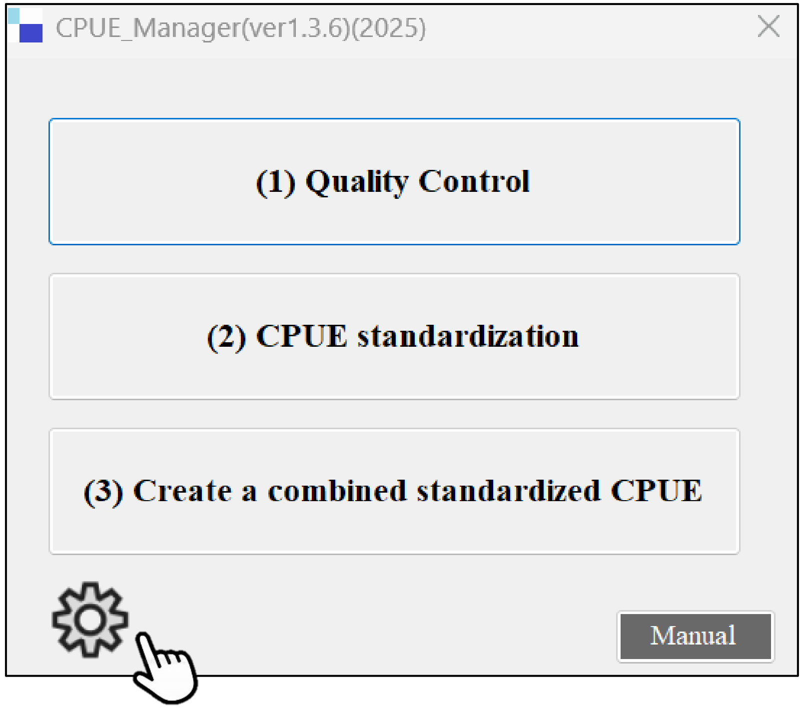
CPUE_Manager(ver1.3.6)(2025)

Congratulations!
The application has been successfully installed.

The application has been successfully installed.

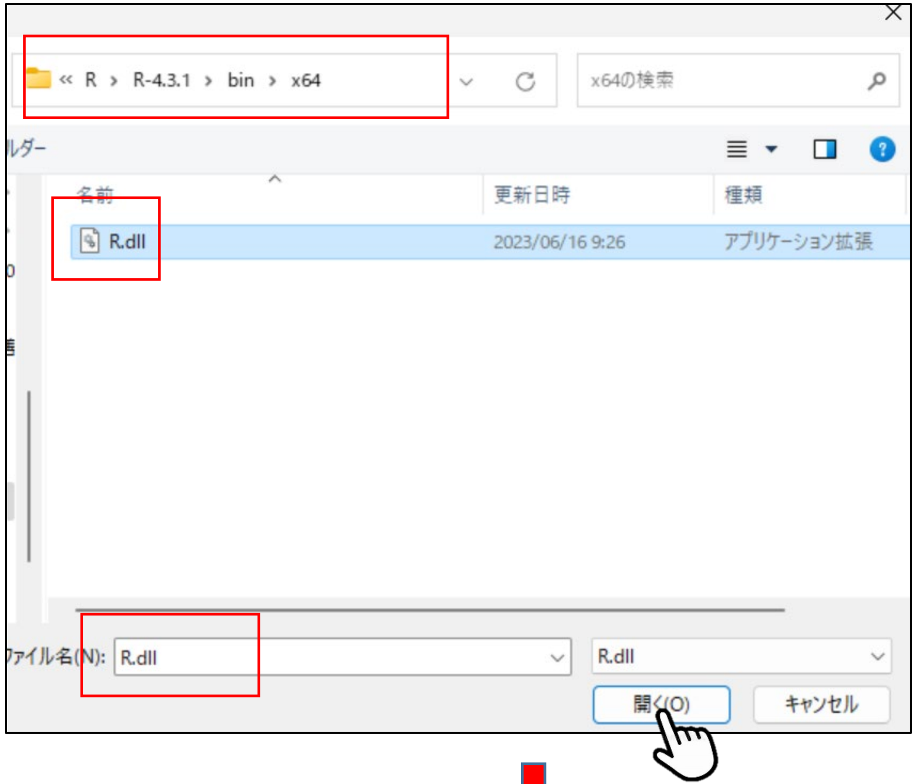
Click the registered icon to start the installed program.

3. Installation： Linking R to CPUE_Manager from the gear mark



Download R for Windows (32/64bit) https://cran.r-project.org/bin/windows/base/

Where is the R.dll? => [normally] (C:)/Program Files/R/R-(Ver. no)/bin/x64/R.dll



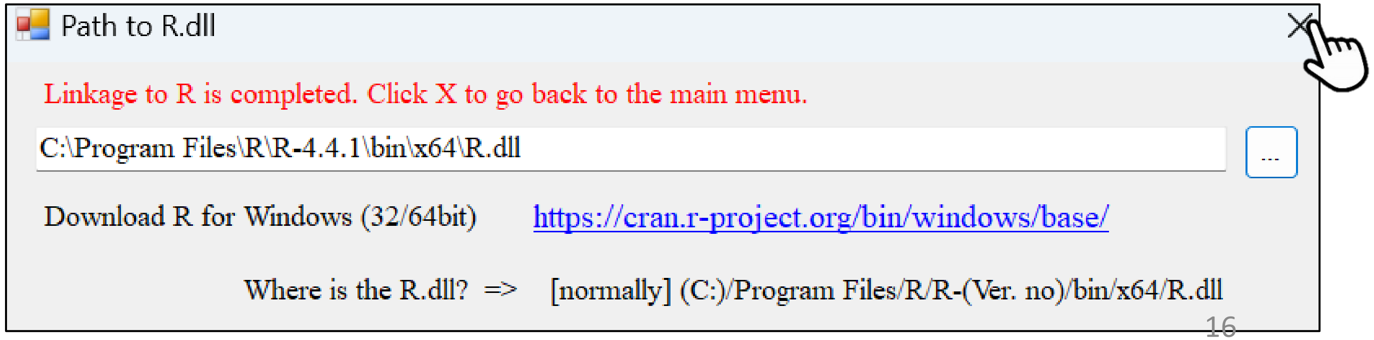
« R › R-4.3.1 › bin › x64

R.dll 2023/06/16 9:26 アプリケーション拡張

ファイル名(N): R.dll

R.dll

Confirmation window



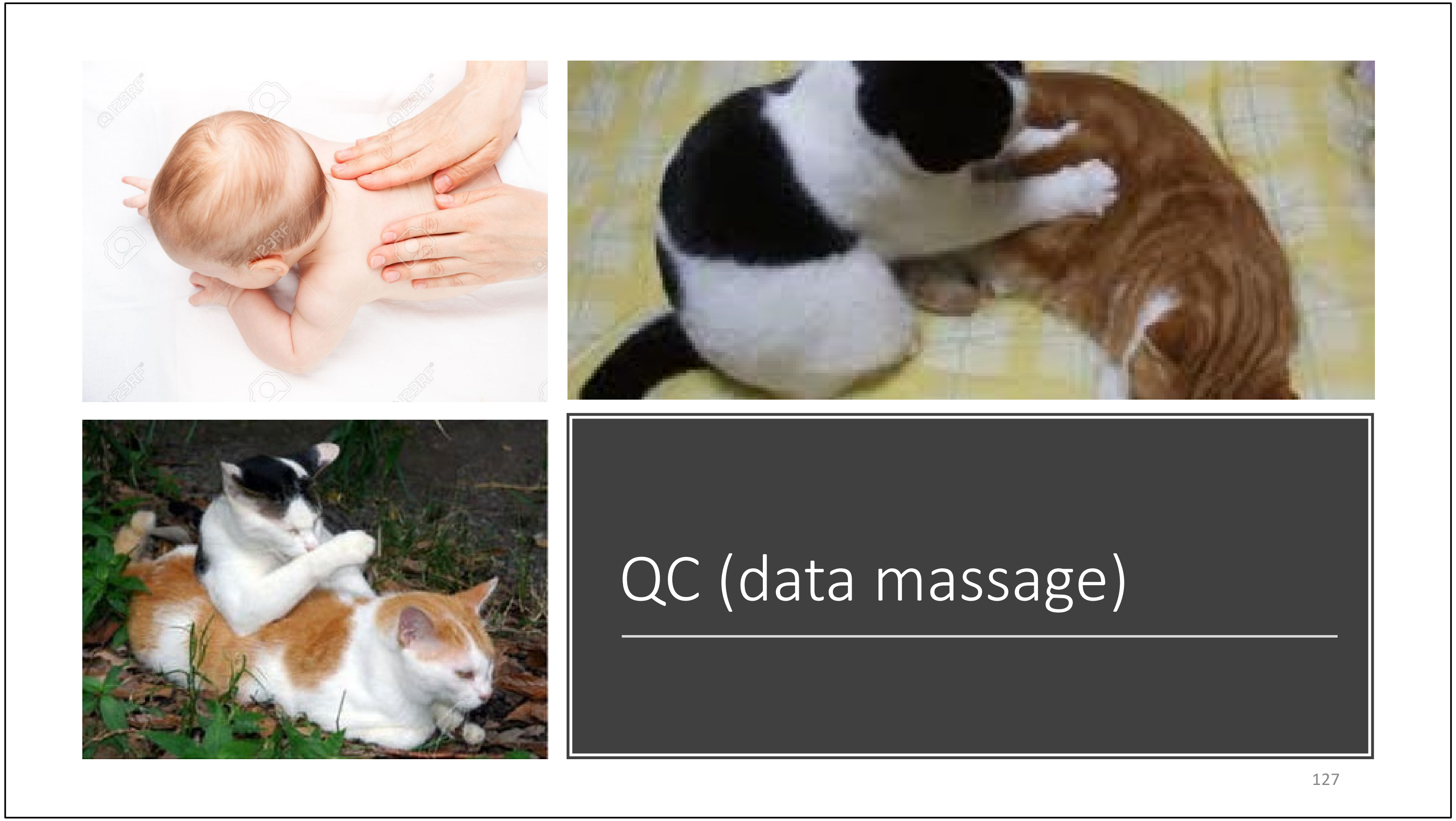
Linkage to R is completed. Click X to go back to the main menu.

C:\Program Files\R\R-4.4.1\bin\x64\R.dll

Download R for Windows (32/64bit) https://cran.r-project.org/bin/windows/base/

Where is the R.dll? => [normally] (C:)/Program Files/R/R-(Ver. no)/bin/x64/R.dll

4. [1st menu] Data Quality Control (QC)

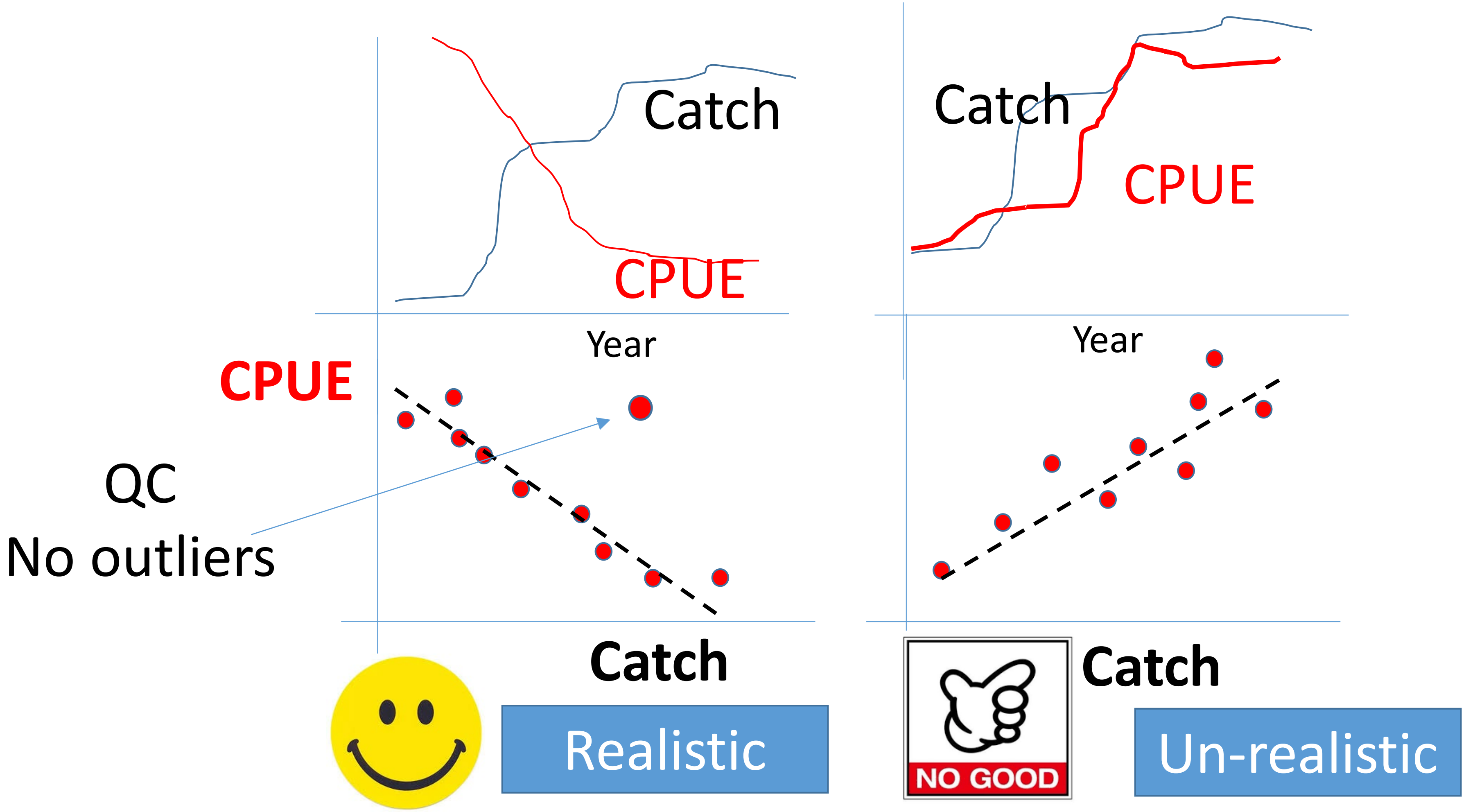


QC (data massage)

127

4. [1st menu] Data Quality Control (QC) : CPUE vs Catch

QC: Catch vs. CPUE => should be inversely correlated (realistic)



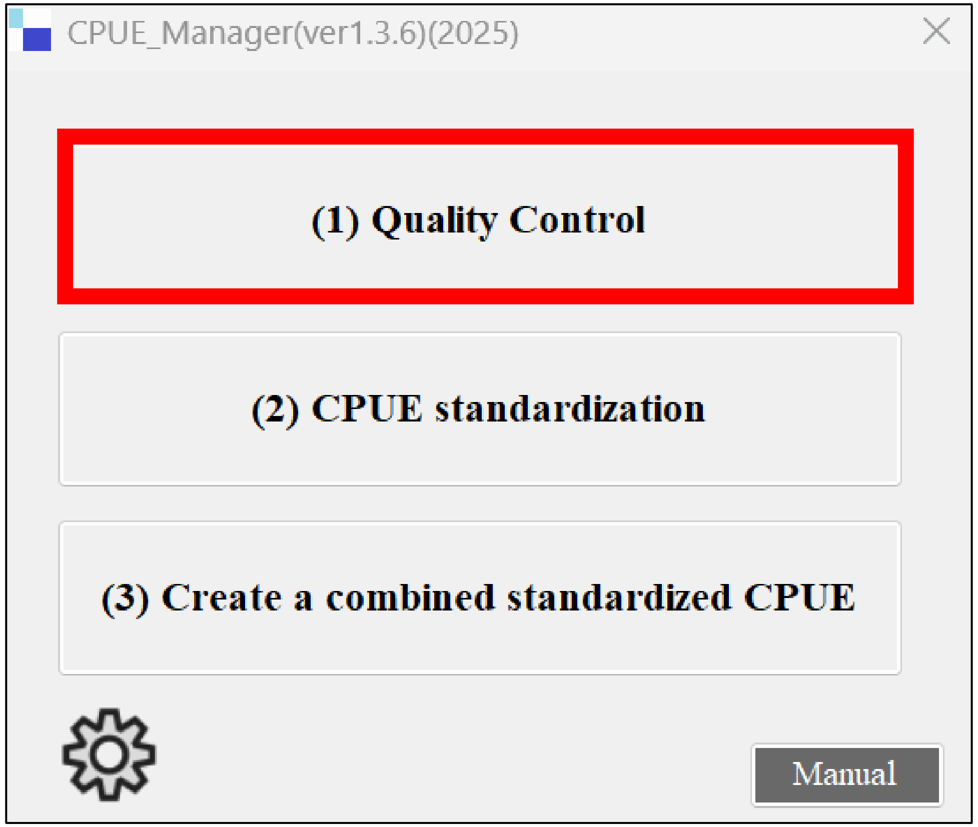
4. [1st menu] Data Quality Control (QC)

To check
relations between CPUE vs. Catch
if there are….
(a) Negative correlations & (b) Outliers

2 ways to do QC based on graphs:
(1) Eye-ball judgments and/or
(2) Statistical judgements
using Prediction Interval(PI)
(for example, 95% PI for predictions)

↓

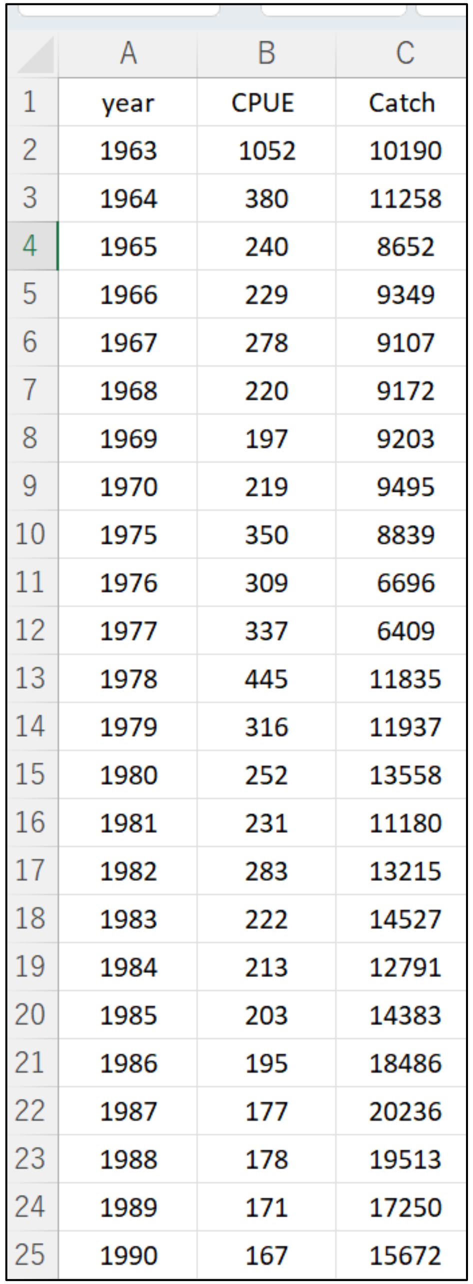
Method (2) will be explained here
using menu (2)



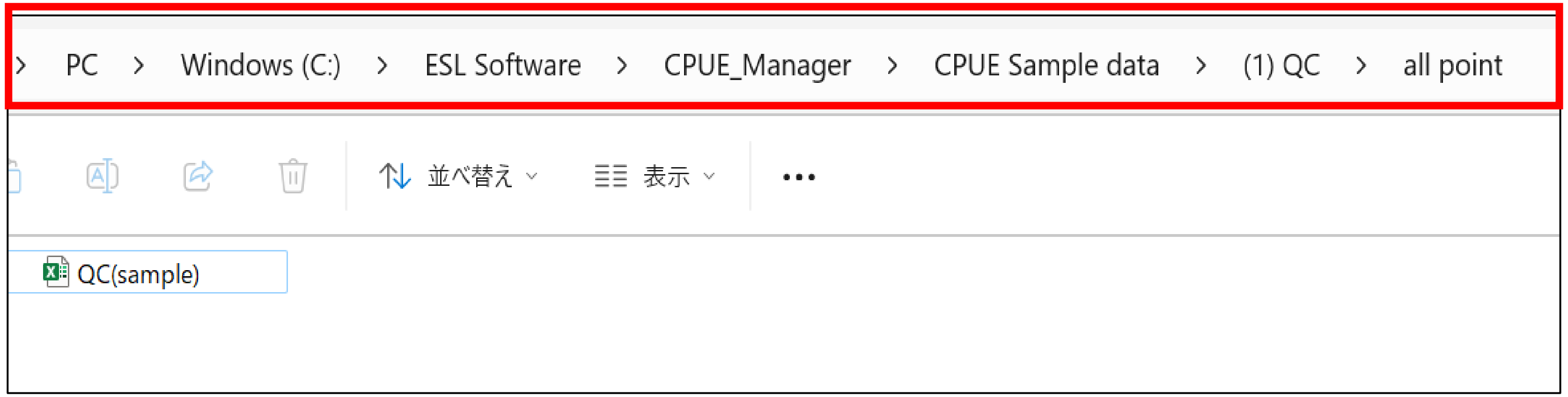
4. [1st menu] Data Quality Control (QC)

Prepare the input data (excel or .csv)

3 variables (year, CPUE, Catch)



	A	B	C
1	year	CPUE	Catch
2	1963	1052	10190
3	1964	380	11258
4	1965	240	8652
5	1966	229	9349
6	1967	278	9107
7	1968	220	9172
8	1969	197	9203
9	1970	219	9495
10	1975	350	8839
11	1976	309	6696
12	1977	337	6409
13	1978	445	11835
14	1979	316	11937
15	1980	252	13558
16	1981	231	11180
17	1982	283	13215
18	1983	222	14527
19	1984	213	12791
20	1985	203	14383
21	1986	195	18486
22	1987	177	20236
23	1988	178	19513
24	1989	171	17250
25	1990	167	15672

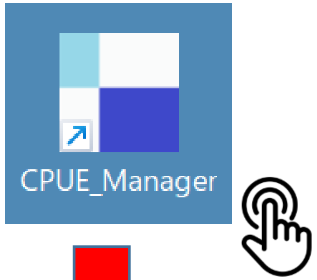


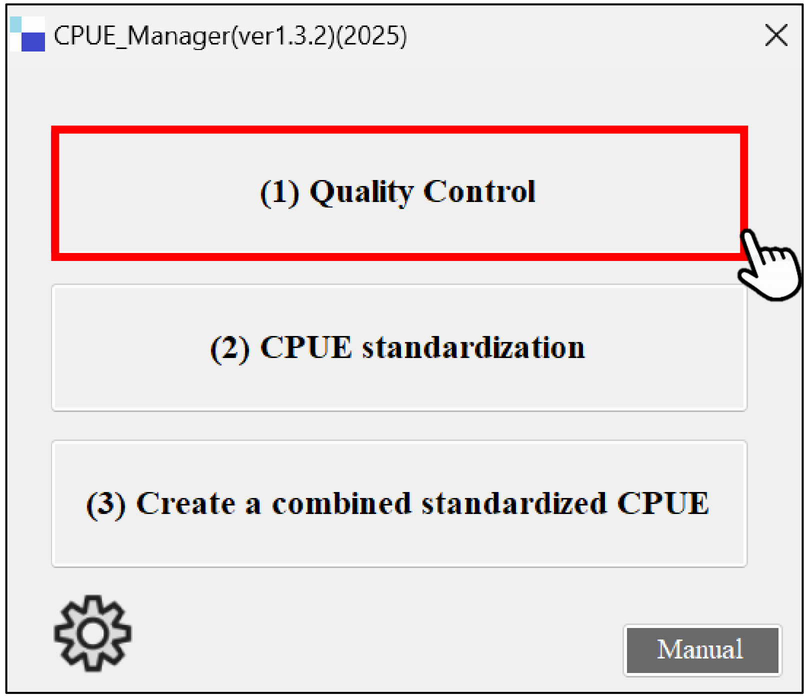
> PC > Windows (C:) > ESL Software > CPUE_Manager > CPUE Sample data > (1) QC > all point

QC(sample)

4. [1st menu] Data Quality Control (QC)

Practice using the sample data ➔ Import the QC(sample) excel file

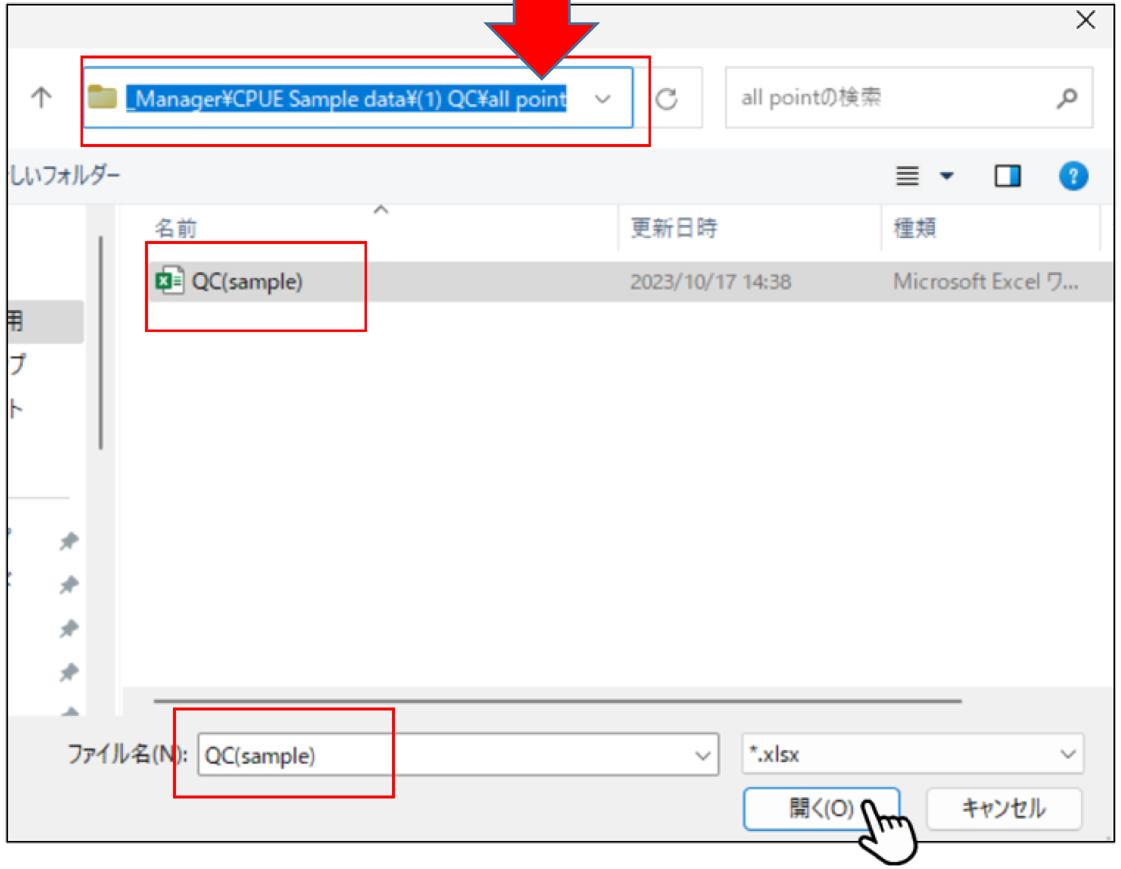




Remarks

If users use this software at the 1st time, the window requests to link R language to this software, will appear.

In such case, follow steps explained in Slide # 13.



名前	更新日時	種類
QC(sample)	2023/10/17 14:38	Microsoft Excel ワ...

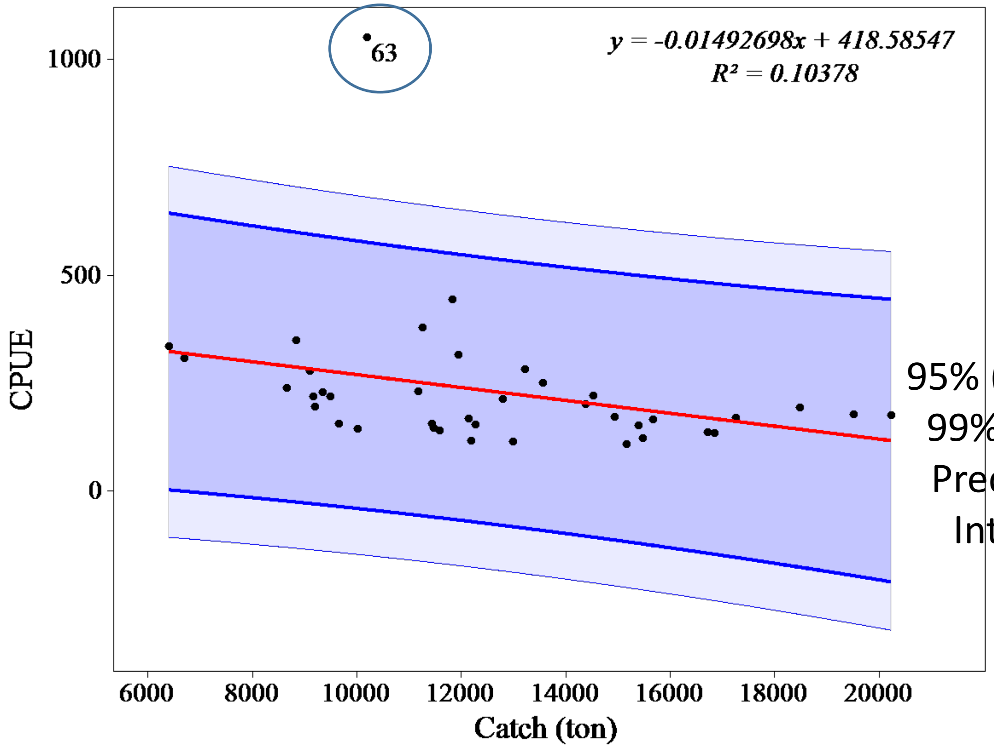
ファイル名(N): QC(sample)

*.xlsx

4. [1st menu] Data Quality Control (QC)

Practice using the sample data

After clicking Open (previous slide), a graph (below) will appear.



95% (dark) & 99% (light) Prediction Interval

From the graph

(1) OK for negative CORR (visually and also from the equation→ negative)

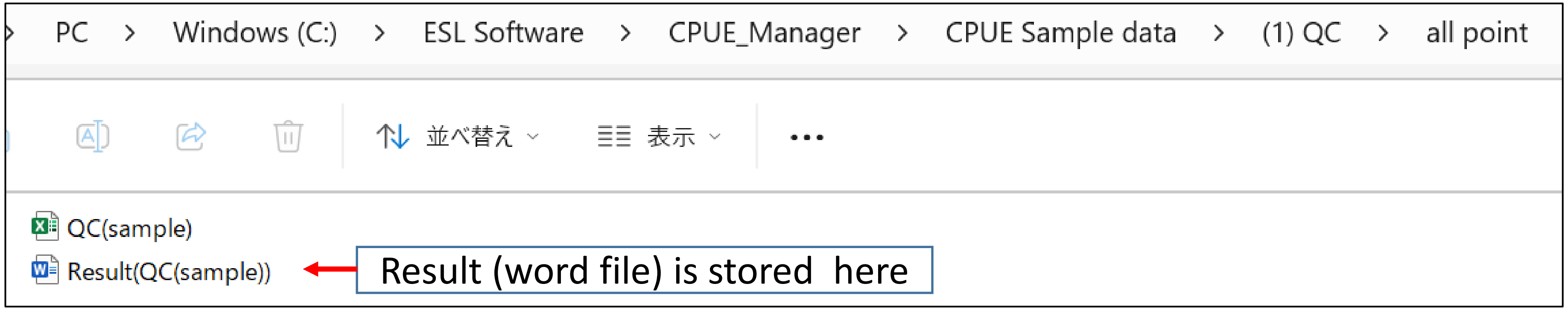
(2) One outlier detected

Such outlier produces biased relations, especially when the sample size is small.

↓

Need to remove

(see next slide)

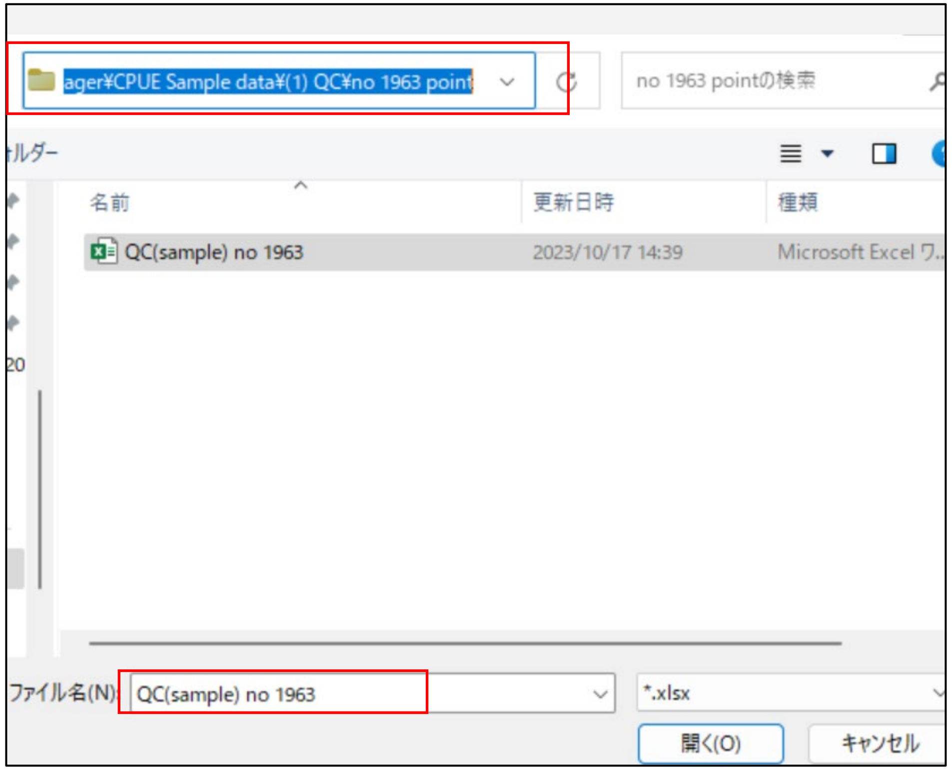


Result (word file) is stored here

4. [1st menu] Data Quality Control (QC) :Practice using the sample data
Further QC without 1963

Make a new excel file, “QC(sample) no 1963”
without the 1963 data point
in the new “no 1963 folder”

Repeat the same operation as before.
Then users get the new result
in the word file (below).

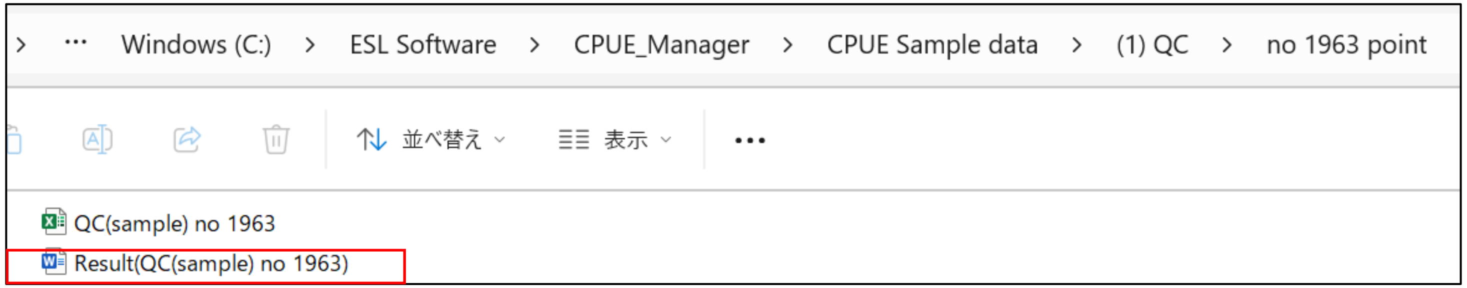


ager¥CPUE Sample data¥(1) QC¥no 1963 point

名前	更新日時	種類
QC(sample) no 1963	2023/10/17 14:39	Microsoft Excel ワ...

ファイル名(N): QC(sample) no 1963

*.xlsx



> ··· Windows (C:) > ESL Software > CPUE_Manager > CPUE Sample data > (1) QC > no 1963 point

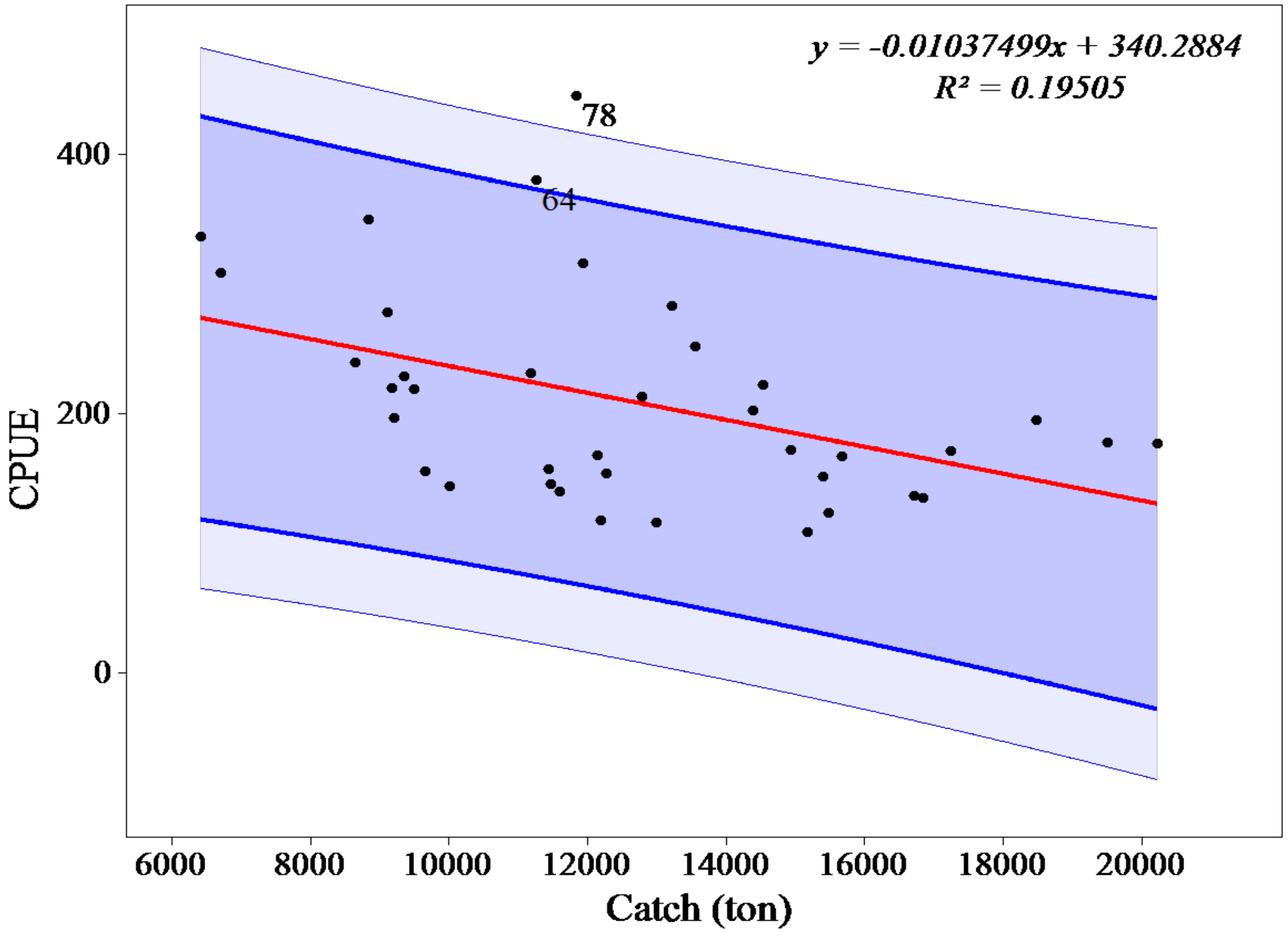
QC(sample) no 1963
Result(QC(sample) no 1963)

See the next slide for the new graph

4. [1st menu] Data Quality Control (QC)

Practice using the sample data ➔ Results

After removal of one outlier (1963)



RESULTS

Negative CORR relation

is improved, i.e.,

r2 increased (10% to 20%)

No need to remove

the 1978 point as close to

the 99% Confidence band.

4. [1st menu] Data Quality Control (QC)

Handling CPUE & catch data with outliers

Outliers mean that CPUE, catch or both are incorrect.
But we don’t know which ones are incorrect.
Thus, we have 3 options.

↓

(1) Both Catch & CPUE should not be used (conservative method)
(2) Use catch but don’t use CPUE if users know catch data is reliable.
(3) Use CPUE but don’t use catch if users know CPUE is reliable.

↓

Decisions will be made by users as they know quality of the data.

4. [1st menu] Data Quality Control (QC)

QC for the original data set (catch and CPUE)

This is not included in the 1st menu.

Thus, users need to do it by themselves.

Original data set includes following variables (example)

→year, month, day, boat name set, area (e.g. grid, fishing grounds), depth, catch, effort, CPUE, weather etc.

4. [1st menu] Data Quality Control (QC)

QC for the original data set (catch and CPUE)

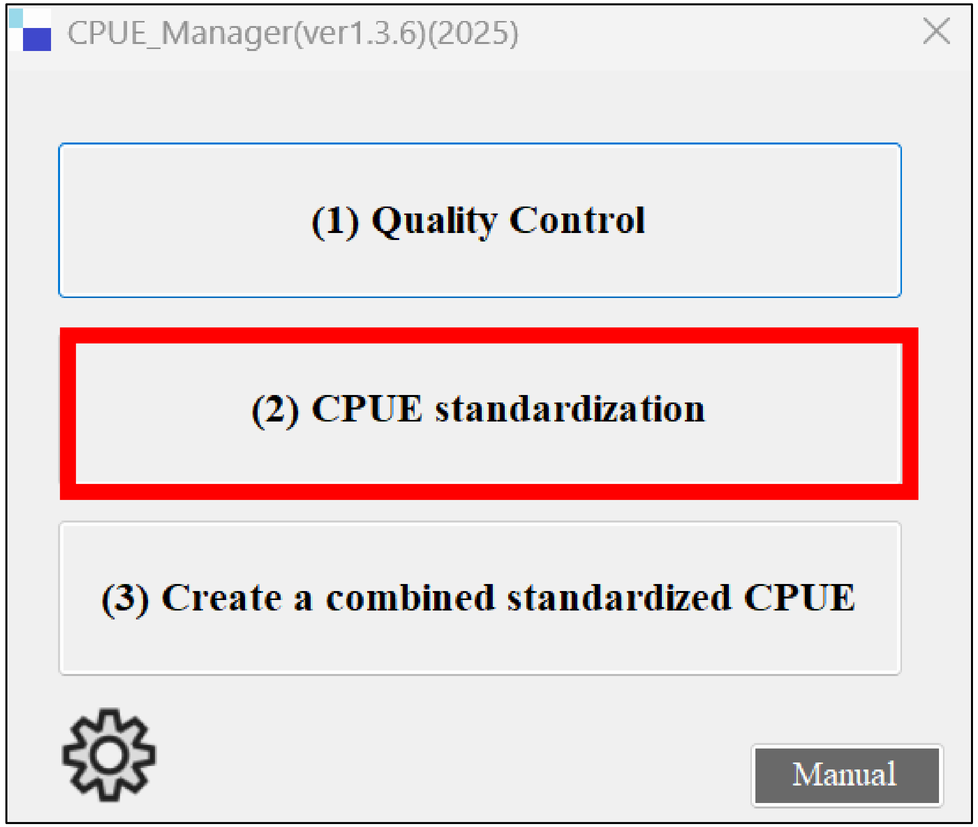
Try standard QC methods

- Check outliers (catch, effort, CPUE, depth and others) (entry errors)
- Check ranges (e.g. if 1<=month<=12)
- Spatial check by mapping (e.g. if catch/effort is not from land)
- Check typos for names (e.g., boat, gear)
- Other ad hoc QC

4. [1st menu] Data Quality Control (QC): In case of JABBA

- If JABBA is used, QC will be done within JABBA, so no need to do QC before running JABBA except the last point (below).
- This is because JABBA can do QC (detections of outliers & implausible CPUE) when it runs.
- JABBA produces many different types of outputs (plots & estimates).
- Some of the outputs can detect outliers and implausible CPUE.
- Users can delete these, re-run & get the final plausible results.
- Please refer to the JABBA manual for details.
- However, even for JABBA, basic QC needs for original catch & CPUE data, must be done as explained in previous 2 pages..

5. [2nd menu] CPUE standardization



5.1 Why we need CPUE standardization?

- Nominal (raw) CPUE

  ➔ Bias➔ not real abundance index

  ➔ not good for stock assessments (SA)

- Major bias affected by ➔ Y(Year), S(Season) & A(Area)

  Other biases

  ➔ Boat type, mesh size, environmental factors (ENV), skipper's ability, targeting etc.

  ➔ All could be explained by YSA because biases are reflected by time & area

  ➔ It is effective if other biases are included in the CPUE standardization

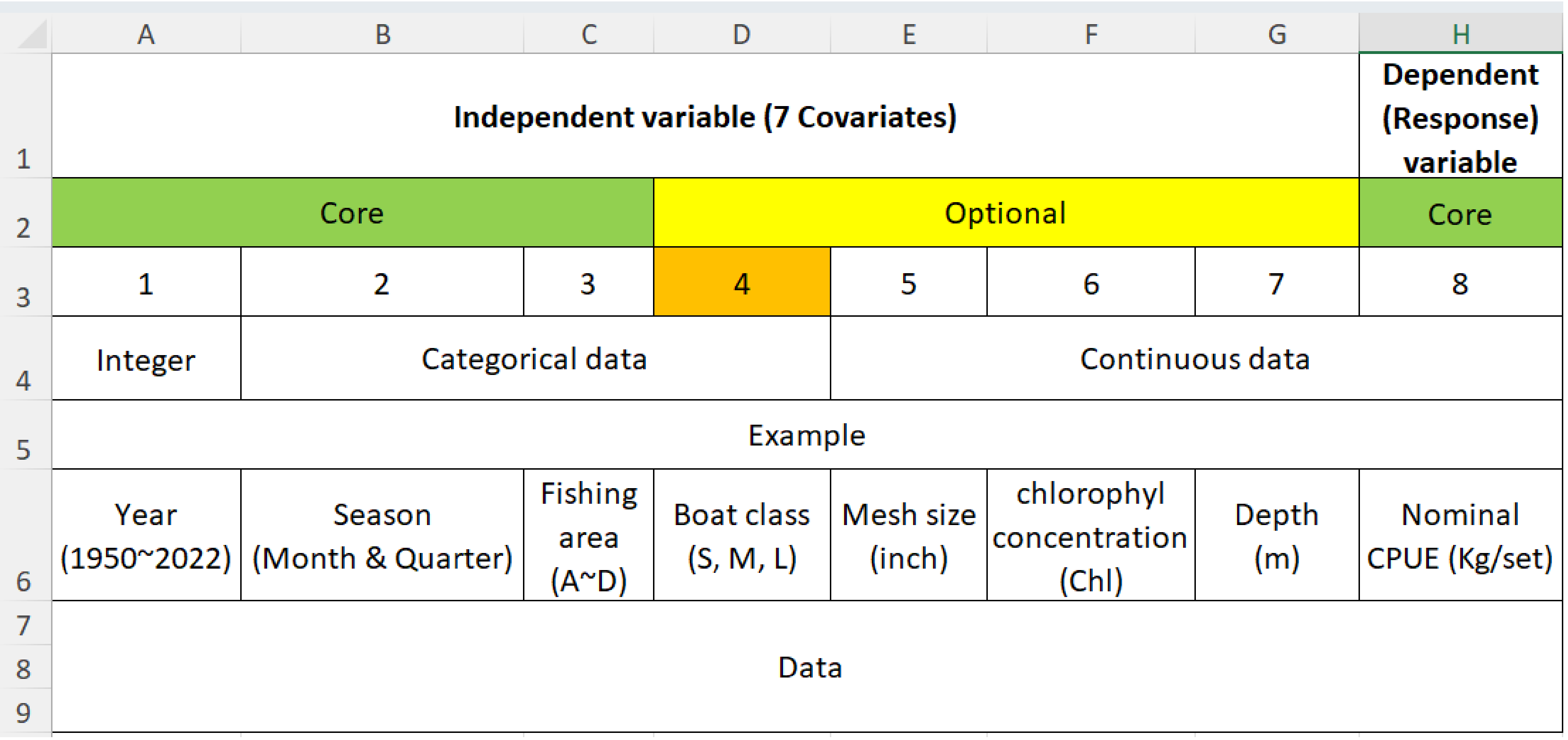
  ➔ This software can handle 4 additional covariates in addition to YSA.

5.2 Creating input data & files

Input file (Excel or CSV file)

Input variables (data) (<u>max 8</u>) & their attributes (Table below)

4 core valuables must be entered. If missing data, enter “. “ (period) except year.

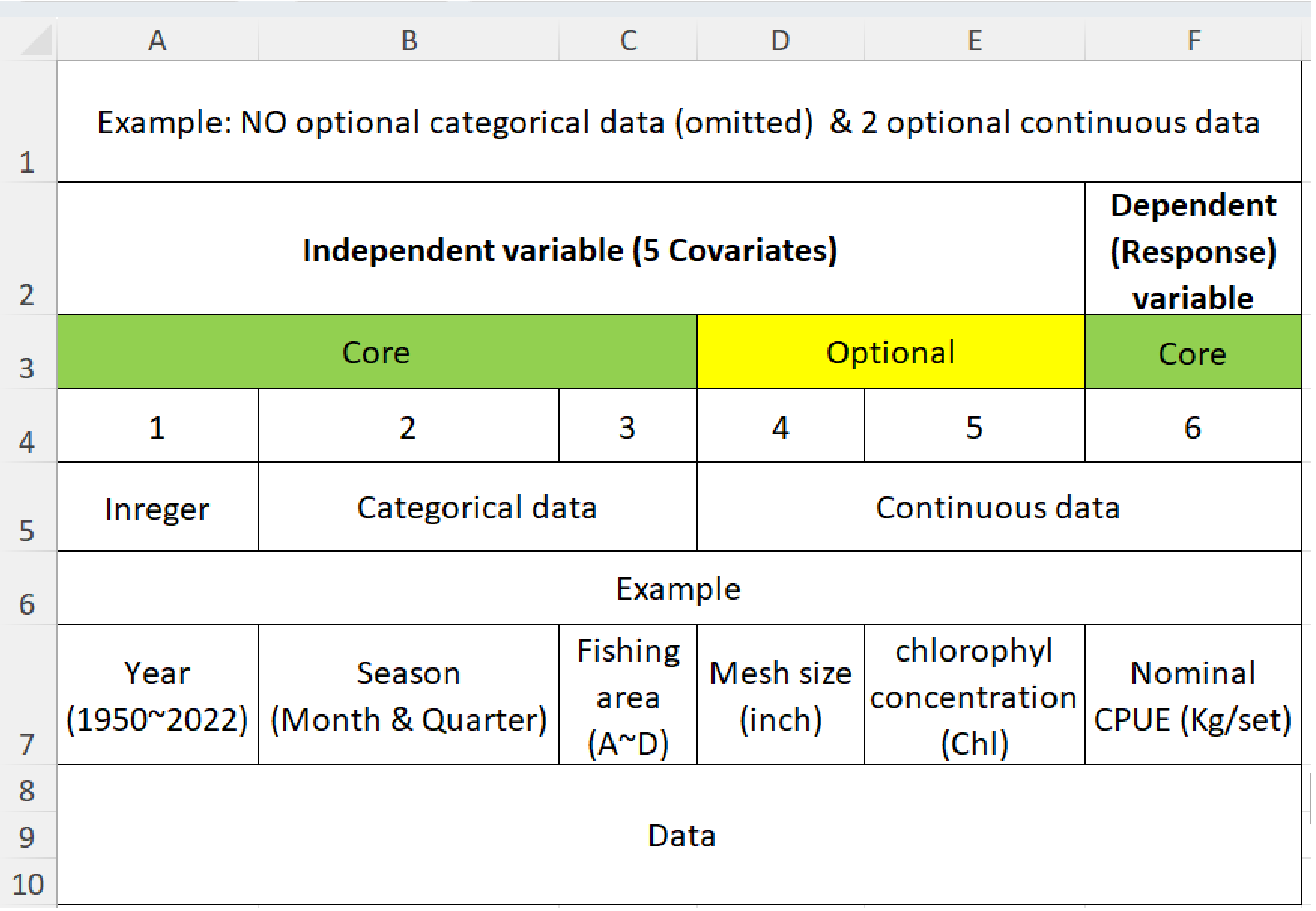


	A	B	C	D	E	F	G	H
1	**Independent variable (7 Covariates)**							**Dependent (Response) variable**
2	Core			Optional				Core
3	1	2	3	4	5	6	7	8
4	Integer	Categorical data			Continuous data			
5	Example							
6	Year (1950~2022)	Season (Month & Quarter)	Fishing area (A~D)	Boat class (S, M, L)	Mesh size (inch)	chlorophyl concentration (Chl)	Depth (m)	Nominal CPUE (Kg/set)
7	Data							
8								
9								

Remarks

The order of the data entry is as above. However, if there are no optional categorical data (#4), its column must be omitted and the other following variables must be filled in continuously (see an example, next page).

Example: If there is no optional categorical data, its column must be omitted (#4 on the previous page)
and the other following variables must be filled in continuously (as below).

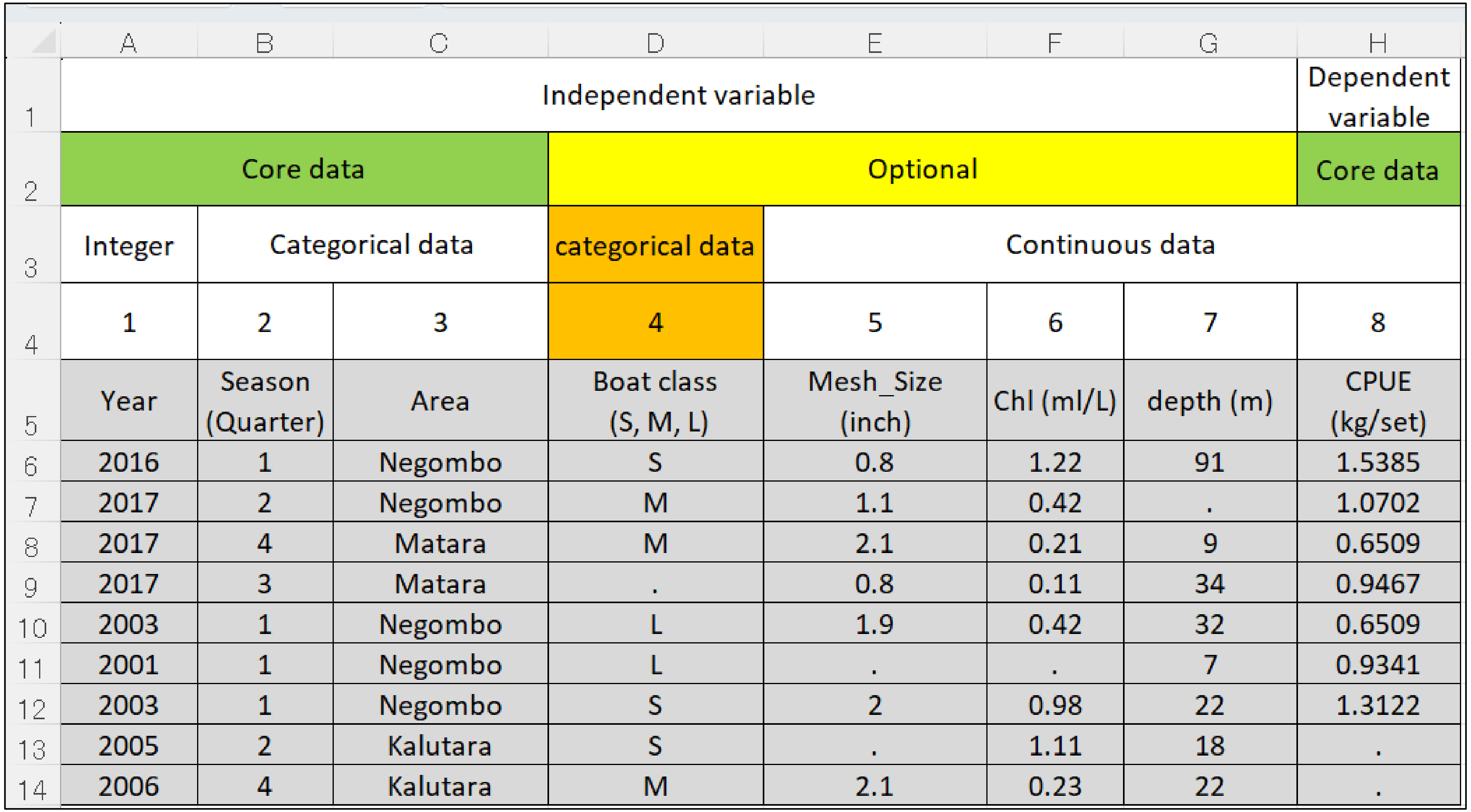


	A	B	C	D	E	F
1	Example: NO optional categorical data (omitted) & 2 optional continuous data					
2	**Independent variable (5 Covariates)**					**Dependent (Response) variable**
3	Core			Optional		Core
4	1	2	3	4	5	6
5	Inreger	Categorical data		Continuous data		
6	Example					
7	Year (1950~2022)	Season (Month & Quarter)	Fishing area (A~D)	Mesh size (inch)	chlorophyl concentration (Chl)	Nominal CPUE (Kg/set)
8	Data					
9						
10						

5.2 Creating input data & files: Sample dataset (8 variables) (max)

"." is missing values & all valuables are not sorted.

Please note that this is an explanatory dataset. The actual data set is the grey area.

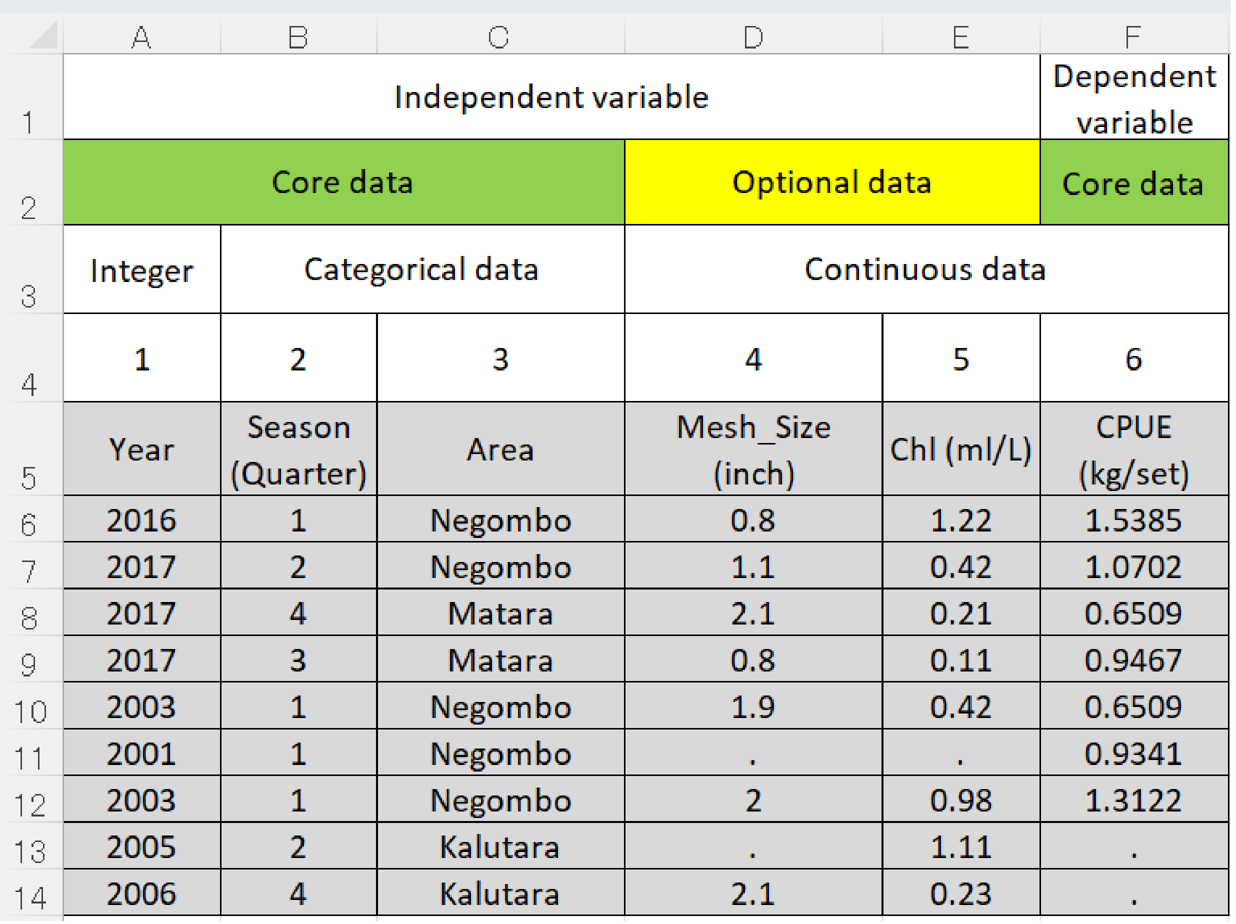


	A	B	C	D	E	F	G	H
1	Independent variable							Dependent variable
2	Core data			Optional				Core data
3	Integer	Categorical data		categorical data	Continuous data			
4	1	2	3	4	5	6	7	8
5	Year	Season (Quarter)	Area	Boat class (S, M, L)	Mesh_Size (inch)	Chl (ml/L)	depth (m)	CPUE (kg/set)
6	2016	1	Negombo	S	0.8	1.22	91	1.5385
7	2017	2	Negombo	M	1.1	0.42	.	1.0702
8	2017	4	Matara	M	2.1	0.21	9	0.6509
9	2017	3	Matara	.	0.8	0.11	34	0.9467
10	2003	1	Negombo	L	1.9	0.42	32	0.6509
11	2001	1	Negombo	L	.	.	7	0.9341
12	2003	1	Negombo	S	2	0.98	22	1.3122
13	2005	2	Kalutara	S	.	1.11	18	.
14	2006	4	Kalutara	M	2.1	0.23	22	.

5.2 Creating input data & files : Another sample dataset (6 variables)

"." is missing values & all data (valuables) are not sorted.

*Please note that this is an explanatory dataset. The actual data set is the **grey area**.*



	A	B	C	D	E	F
1	Independent variable					Dependent variable
2	Core data			Optional data		Core data
3	Integer	Categorical data		Continuous data		
4	1	2	3	4	5	6
5	Year	Season (Quarter)	Area	Mesh_Size (inch)	Chl (ml/L)	CPUE (kg/set)
6	2016	1	Negombo	0.8	1.22	1.5385
7	2017	2	Negombo	1.1	0.42	1.0702
8	2017	4	Matara	2.1	0.21	0.6509
9	2017	3	Matara	0.8	0.11	0.9467
10	2003	1	Negombo	1.9	0.42	0.6509
11	2001	1	Negombo	.	.	0.9341
12	2003	1	Negombo	2	0.98	1.3122
13	2005	2	Kalutara	.	1.11	.
14	2006	4	Kalutara	2.1	0.23	.

This is the case when there is no optional categorical data i.e., its column is omitted (#4 on the previous page) and the other following variables are filled in continuously.

5.2 Creating input data & files: Merging 2 data sets

Often the main CPUE datasets and the additional datasets (typically, the environmental data) need to be merged into one dataset.

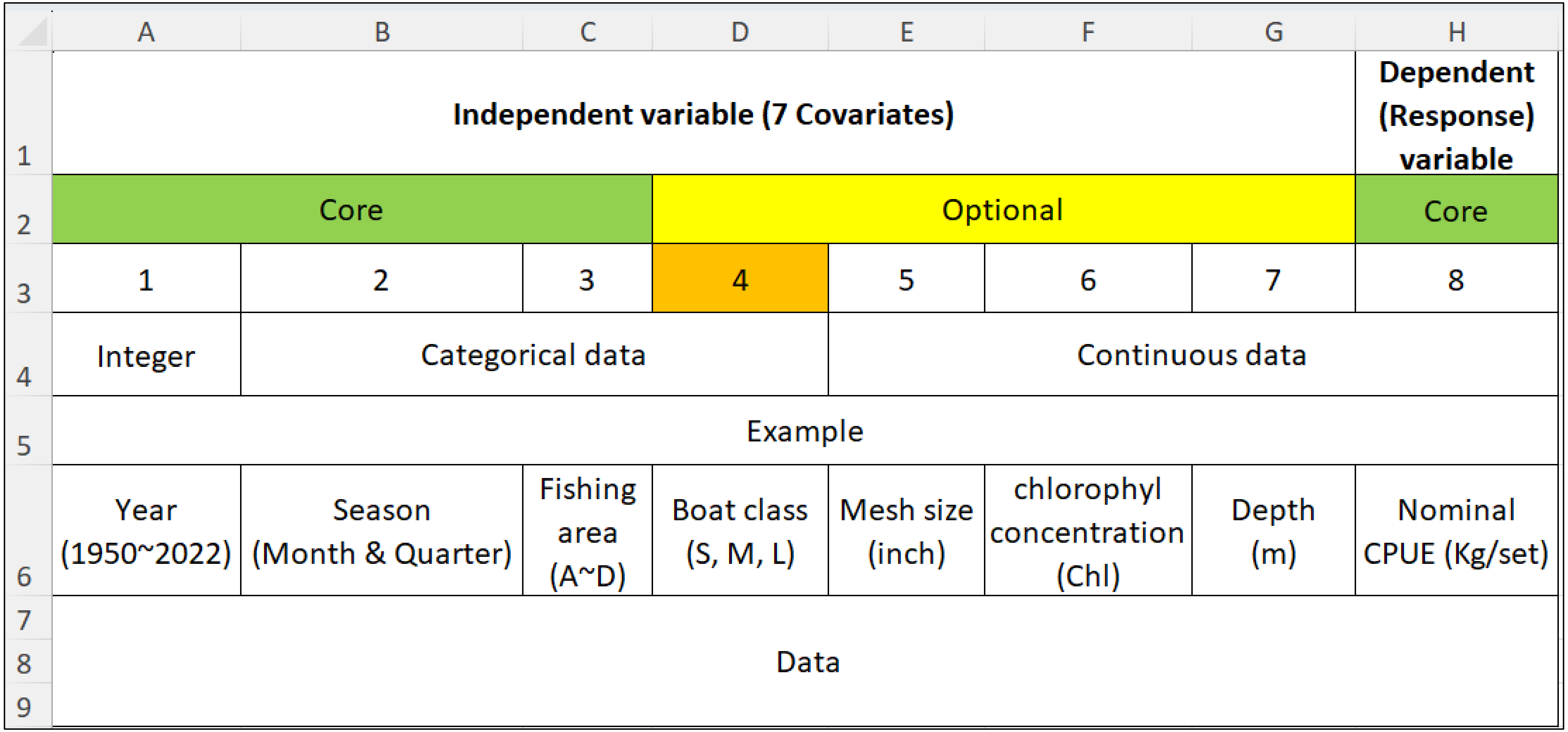
↓

This will require some technical processing in Excel.

↓

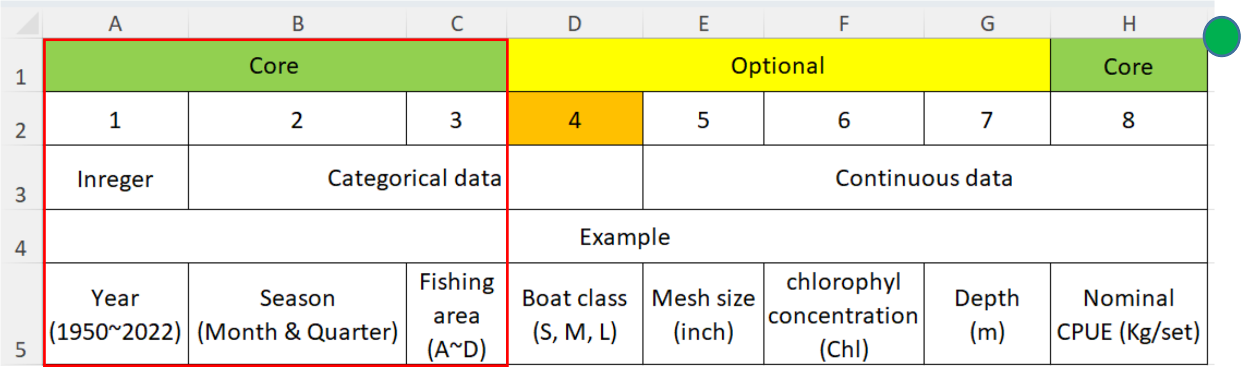
Please ask your colleagues, check the Excel manual or ask [MENU]

5.3 Attributes of variables



	A	B	C	D	E	F	G	H
1	**Independent variable (7 Covariates)**							**Dependent (Response) variable**
2	Core			Optional				Core
3	1	2	3	4	5	6	7	8
4	Integer	Categorical data			Continuous data			
5	Example							
6	Year (1950~2022)	Season (Month & Quarter)	Fishing area (A~D)	Boat class (S, M, L)	Mesh size (inch)	chlorophyl concentration (Chl)	Depth (m)	Nominal CPUE (Kg/set)
7	Data							
8								
9								

5.3 Attributes of 8 variables
[1]~[3] Core Covariates



	A	B	C	D	E	F	G	H
1	Core			Optional				Core
2	1	2	3	4	5	6	7	8
3	Inreger	Categorical data			Continuous data			
4	Example							
5	Year (1950~2022)	Season (Month & Quarter)	Fishing area (A~D)	Boat class (S, M, L)	Mesh size (inch)	chlorophyl concentration (Chl)	Depth (m)	Nominal CPUE (Kg/set)

[1] Year : Western (Christian) year (AD)

➔ *positive integer (e.g. 1950, 1951,…, 2025)*

<u>no missing years</u>

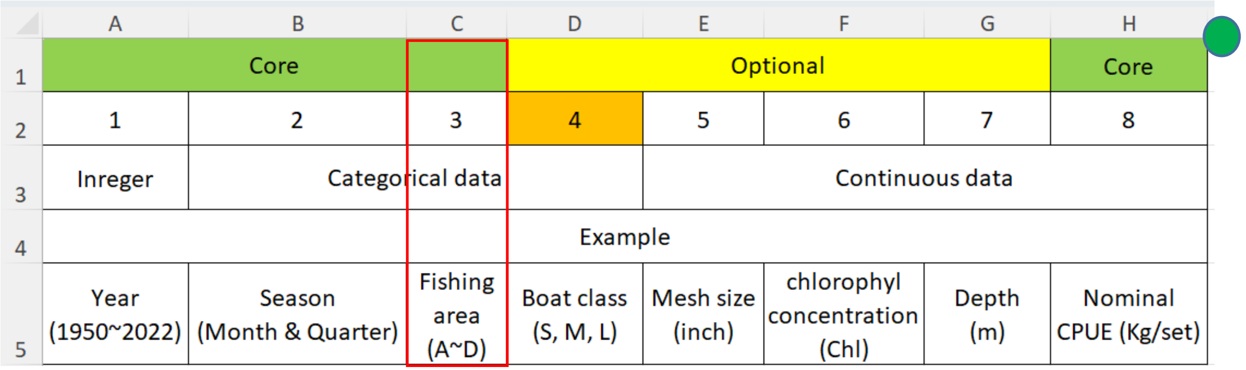
[2] Season : Month, quarter, semi-annual, etc.

If no data ➔ *enter the missing values (.)*

[3] Area : 3 types (see next slides for details)

If no data ➔ *enter the missing values (.)*

5.3 Attributes of 8 variables
[3] Area : Habitat area (3 types)



	A	B	C	D	E	F	G	H
1	Core			Optional				Core
2	1	2	3	4	5	6	7	8
3	Inreger	Categorical data			Continuous data			
4	Example							
5	Year (1950~2022)	Season (Month & Quarter)	Fishing area (A~D)	Boat class (S, M, L)	Mesh size (inch)	chlorophyl concentration (Chl)	Depth (m)	Nominal CPUE (Kg/set)

Habitat area should be used for area

(grids, fishing grounds or landing sites)

<u>At least 1 catch in past in such area</u>

If area is larger than the habitat area many 0 catch (not realistic) ➔ bias

If larger area than the habitat area is used,

many 0 CPUE will be produced & provide biased abundance index

Habitat area (at lease 1 fish in the past)

(use this area)

5.3 Attributes of 8 variables
[3] Area (3 types)

(1) Grids, (2) Fishing grounds and (3) Landing sites

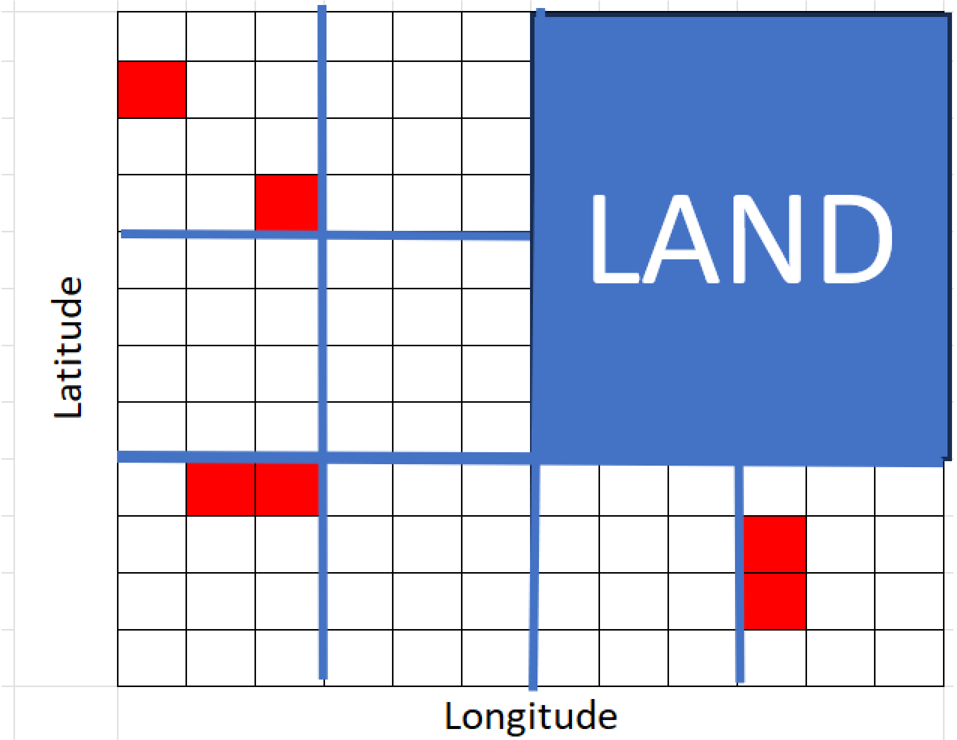
by preferable order

↓

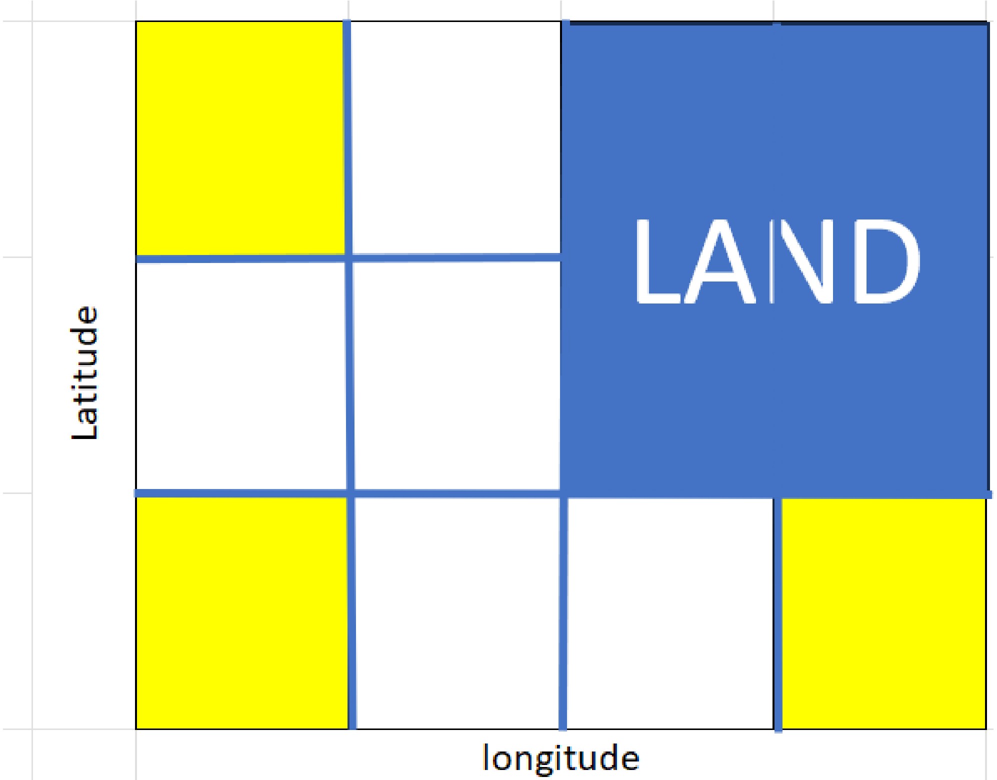
Because more pin-pointed anomalies can be reflected in CPUE standardization

5.3 Attributes of 8 variables **[3] Area**

(1) Grid (lat/long) : Fine scale → better
as more pin-pointed anomalies can be reflected in CPUE standardization

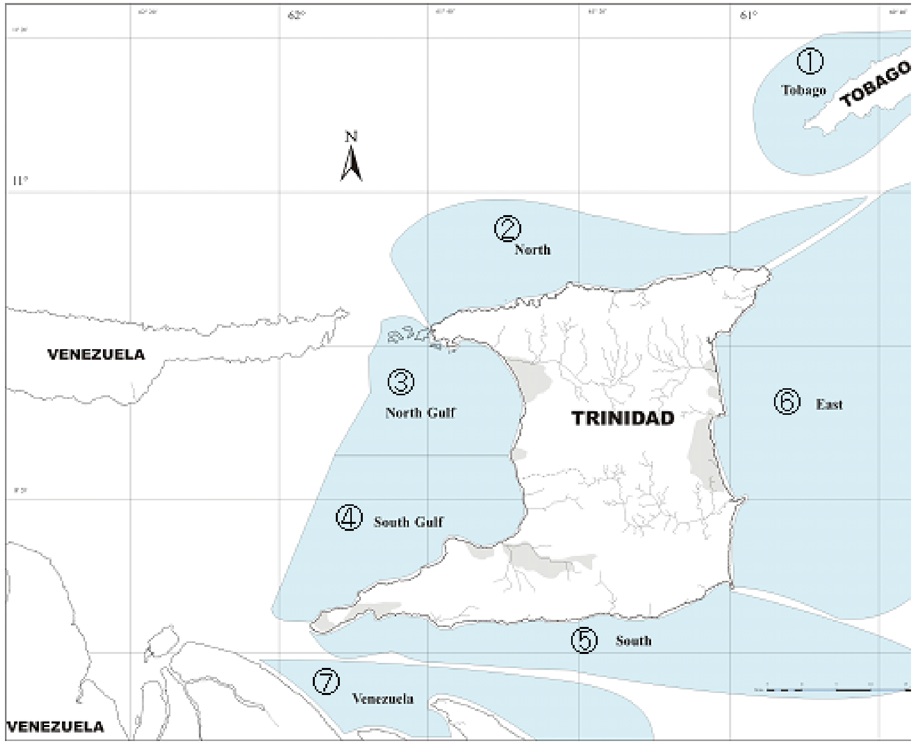


🟥 Fine scale grids clearly show areas of high anomaly where nominal CPUE is specifically affected, making CPUE standardization effective.

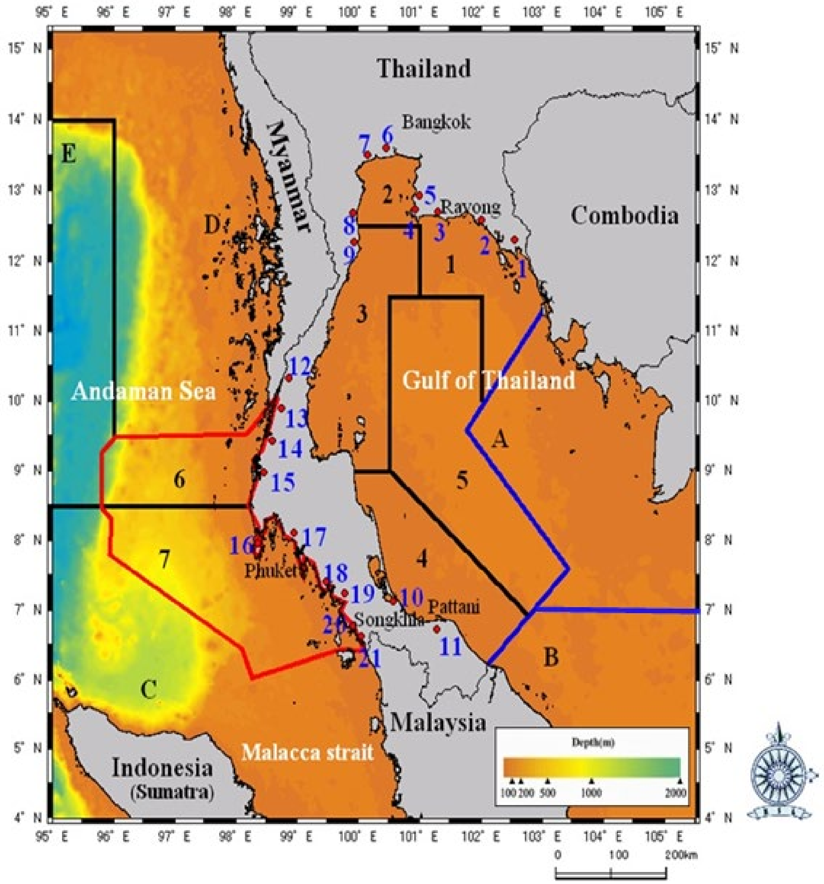


🟨 Coarse scale grids reflect average anomaly areas (compared to right) where the effects of nominal CPUE are vague, making CPUE standardization less effective.

5.3 Attributes of 8 variables
[3] Area
(2) Fishing grounds: finer is better (same reason)



Trinidad and Tobago (area ①～⑦)

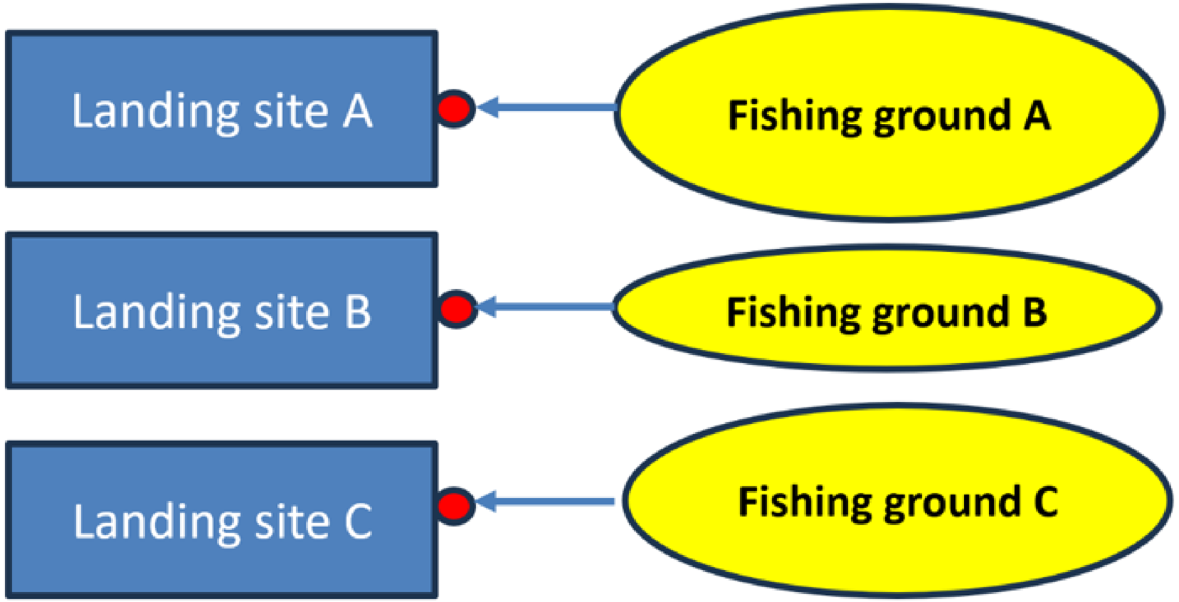


Thailand

Gulf of Thailand (area 1～5, A and B) and Andaman Sea (area 6,7 and C～F)

5.3 Attributes of 8 variables
[3] Area
(3) Landing sites ➔ should represent the fishing grounds [Type A] [Type B] should not be used.

[Type A] Landing sites represents exact fishing grounds



Landing site A

Fishing ground A

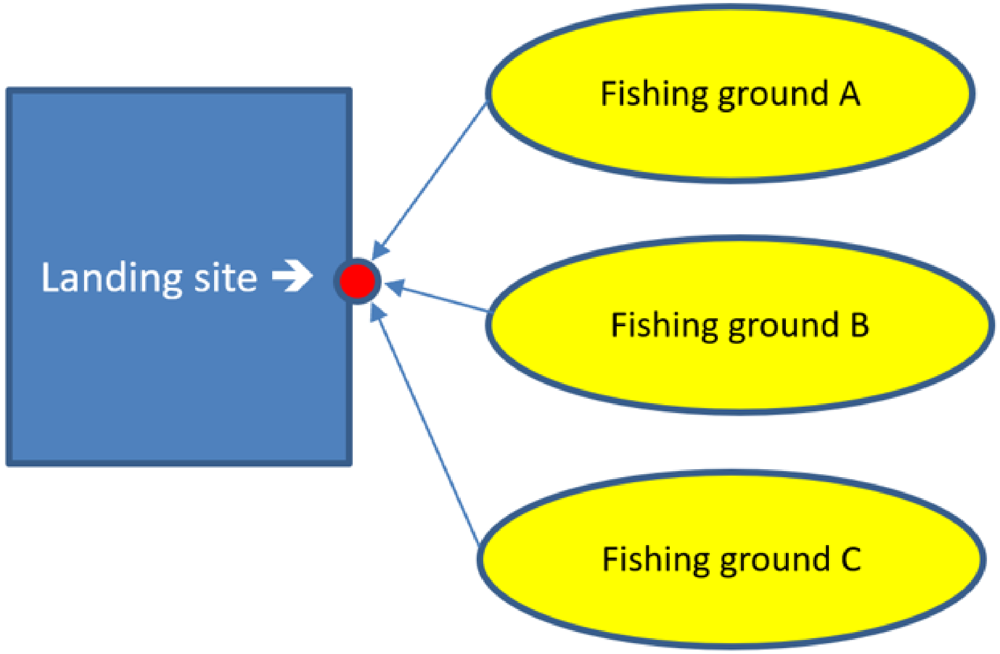
Landing site B

Fishing ground B

Landing site C

Fishing ground C

[Type B] Landing site representing multiple fishing grounds



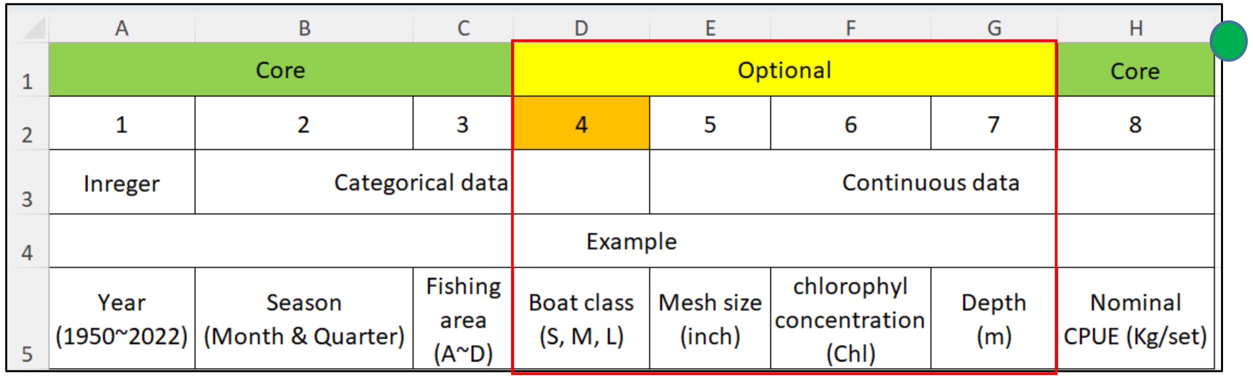
Landing site ➔

Fishing ground A

Fishing ground B

Fishing ground C

5.3 Attributes of 8 variables
[4]~[7] Optional Covariates



	A	B	C	D	E	F	G	H
1	Core			Optional				Core
2	1	2	3	4	5	6	7	8
3	Inreger	Categorical data				Continuous data		
4				Example				
5	Year (1950~2022)	Season (Month & Quarter)	Fishing area (A~D)	Boat class (S, M, L)	Mesh size (inch)	chlorophyl concentration (Chl)	Depth (m)	Nominal CPUE (Kg/set)

4. **Categorical** data Example: Boat class (small, medium, large)

Skipper's skill (normal, good, excellent)

Gear maker (firm A, B, C & D)

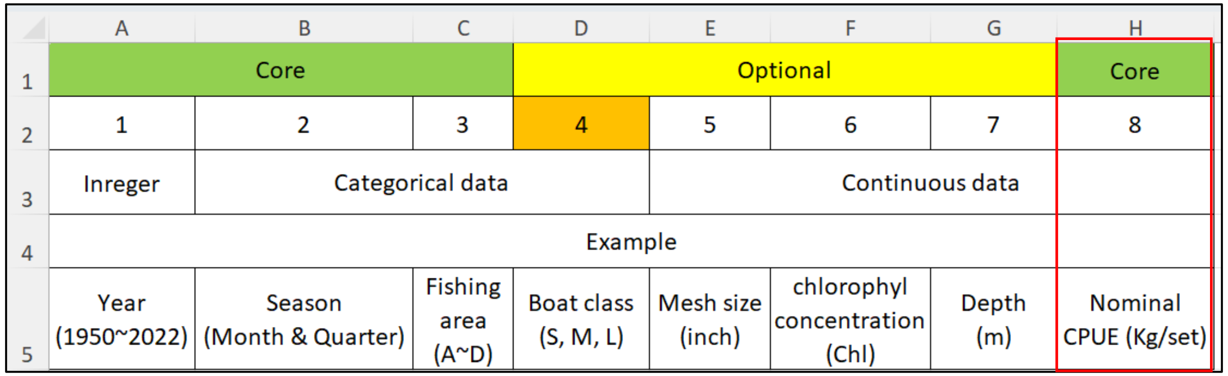
5.~7. **Continuous** variable Example: Environmental data

(e.g. temperature, salinity, depth,

chlorophyl concentration, etc.)

Mesh size, etc.

5.3 Attributes of 8 variables
[8] Nominal CPUE
Core (dependent) variable



	A	B	C	D	E	F	G	H
1	Core			Optional				Core
2	1	2	3	4	5	6	7	8
3	Inreger	Categorical data			Continuous data			
4	Example							
5	Year (1950~2022)	Season (Month & Quarter)	Fishing area (A~D)	Boat class (S, M, L)	Mesh size (inch)	chlorophyl concentration (Chl)	Depth (m)	Nominal CPUE (Kg/set)

Unit

Kg/set, Kg/Haul, Kg/hook, ton/set etc.

Spatial scale

finer scale better

➔pin-pointed (plausible) anomalies can be reflected in STD_CPUE

Time scale

Finer scale better, i.e.,

“set by set” (see next page), “daily by boat”, “daily (aggregated)”, “monthly”, “Quarterly”, and “Semi-annual”.

5.3 Attributes of 8 variables
Core (dependent) variable
[8] Nominal CPUE : What is the set-by-set & coarse scale data?

"Set" is the minimum unit of fishing operation such as haul
including fishing effort such as number of hooks, nets, lines, etc.

↓

This will provide the minimum unit of nominal CPUE
such as Kg/hook/set
called as fine scale data

↓

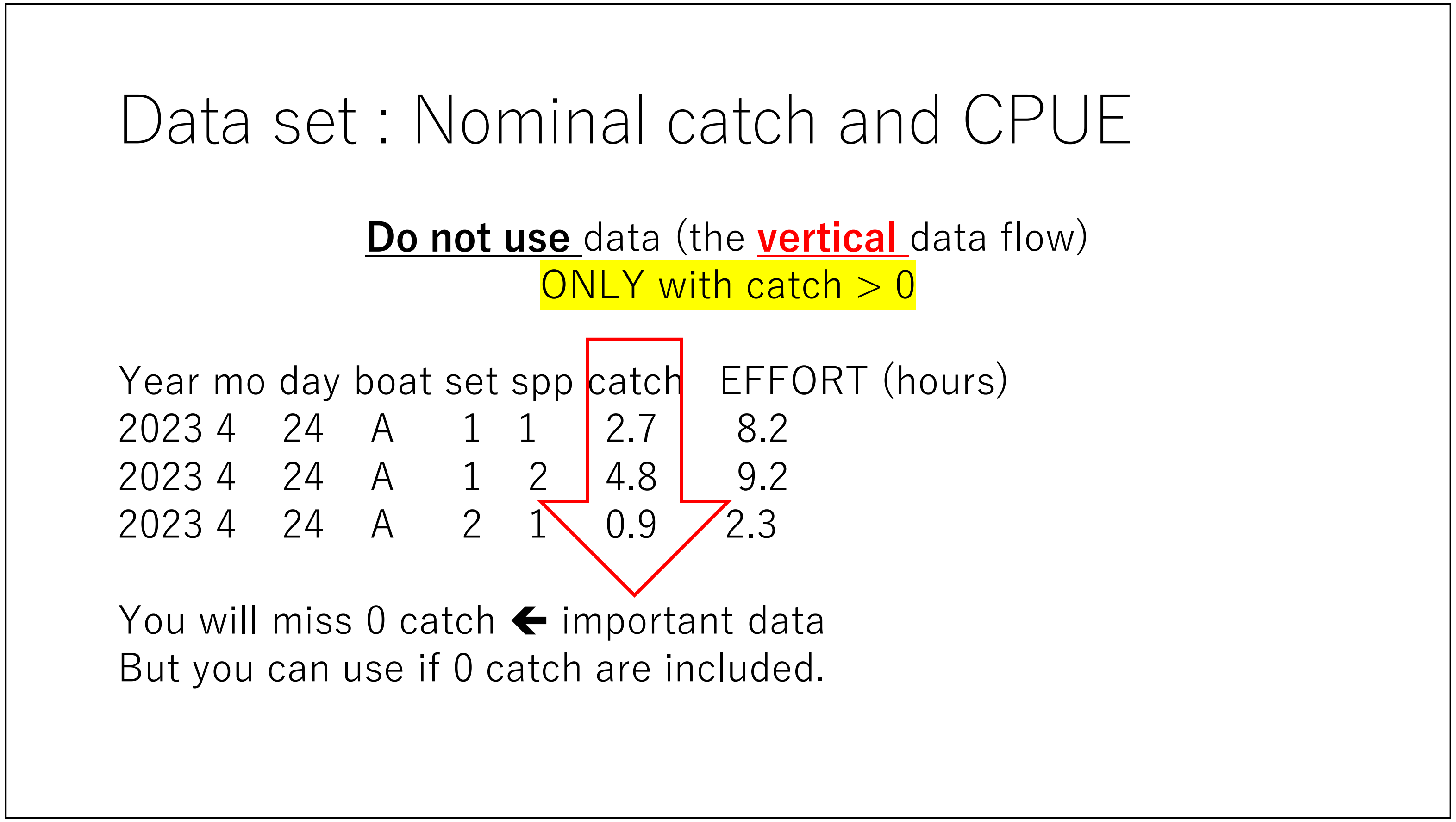
Fine scale nominal CPUE will provide more plausible abundance index
when it is standardized because

5.3 Attributes of 8 variables
[8] Nominal CPUE : Important note

<u>0 (zero) catch (CPUE) data should be included</u>

Don't use vertical data set format (below) as quite often 0 catch is not entered

If 0 catch is included ➔ OK



Data set : Nominal catch and CPUE

<u>Do not use</u> data (the **<u>vertical</u>** data flow)
ONLY with catch > 0

Year	mo	day	boat	set	spp	catch	EFFORT (hours)
2023	4	24	A	1	1	2.7	8.2
2023	4	24	A	1	2	4.8	9.2
2023	4	24	A	2	1	0.9	2.3

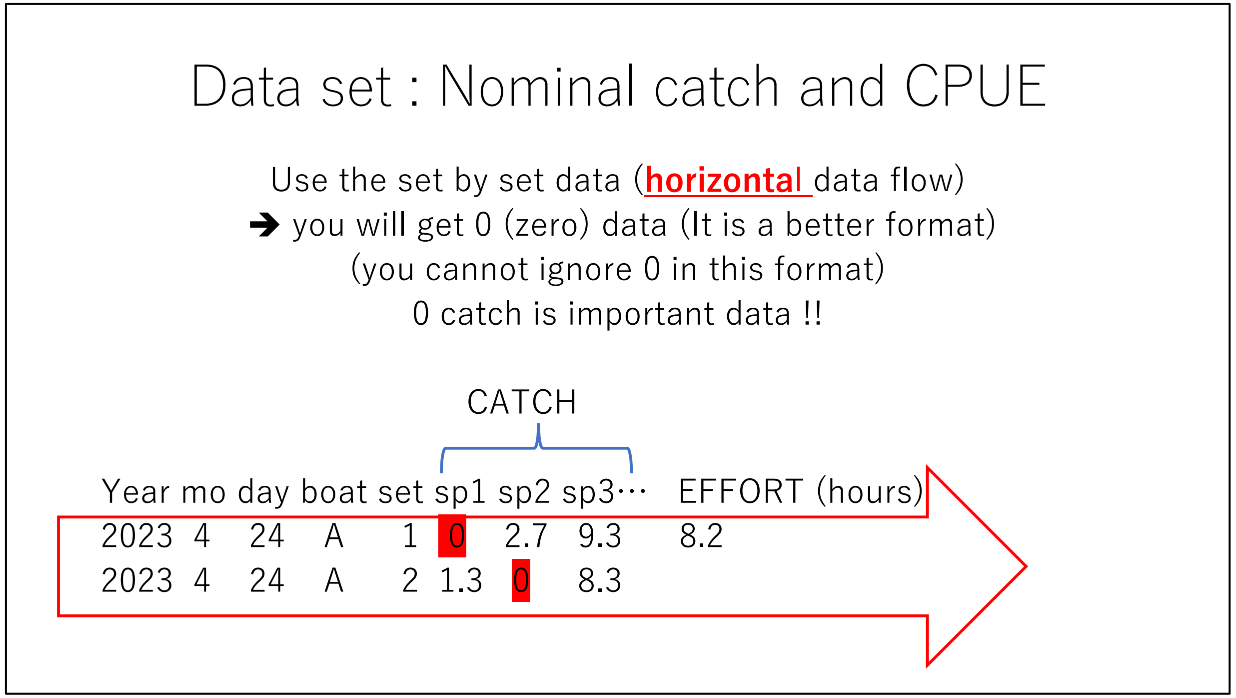
You will miss 0 catch 🡐 important data
But you can use if 0 catch are included.

5.3 Attributes of 8 variables
[8] Nominal CPUE : Important note

<u>0 (zero) catch (CPUE) data should be included</u>

Use horizontal data format (below)

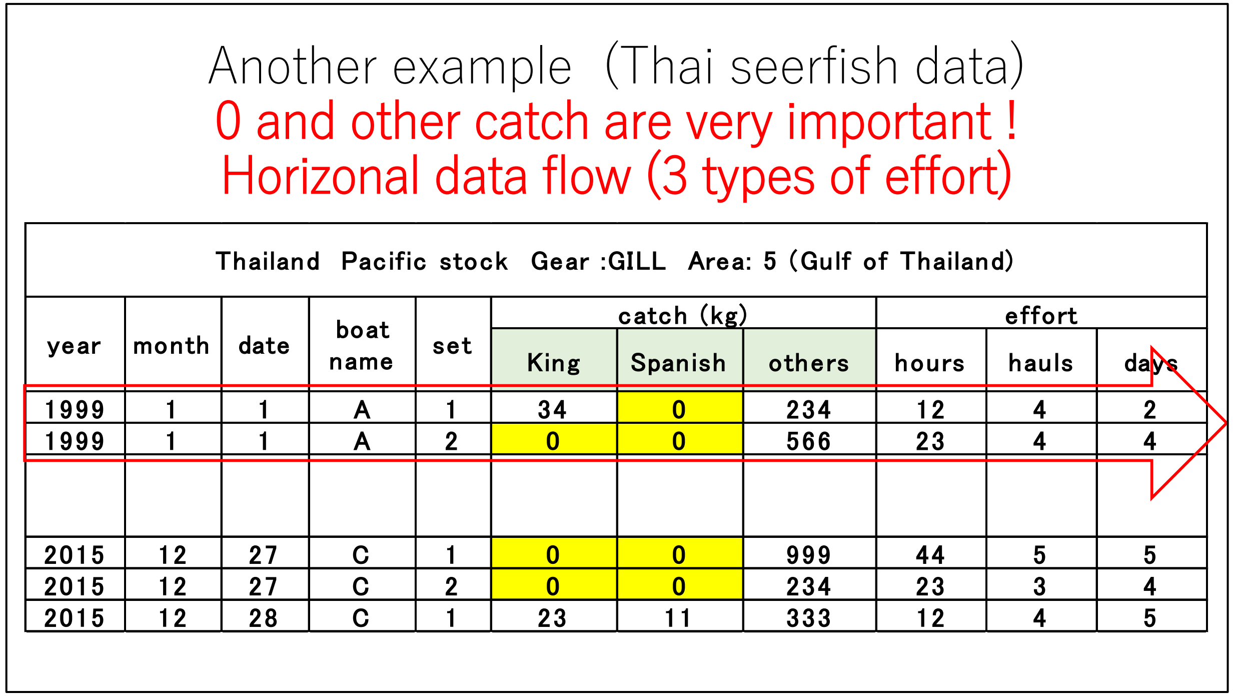
➔ all catch (incl. 0) (all species) can be entered presented



Data set : Nominal catch and CPUE

Use the set by set data (**horizontal** data flow)
➔ you will get 0 (zero) data (It is a better format)
(you cannot ignore 0 in this format)
0 catch is important data !!

					CATCH			
Year	mo	day	boat	set	sp1	sp2	sp3···	EFFORT (hours)
2023	4	24	A	1	0	2.7	9.3	8.2
2023	4	24	A	2	1.3	0	8.3	



Another example (Thai seerfish data)
0 and other catch are very important !
Horizonal data flow (3 types of effort)

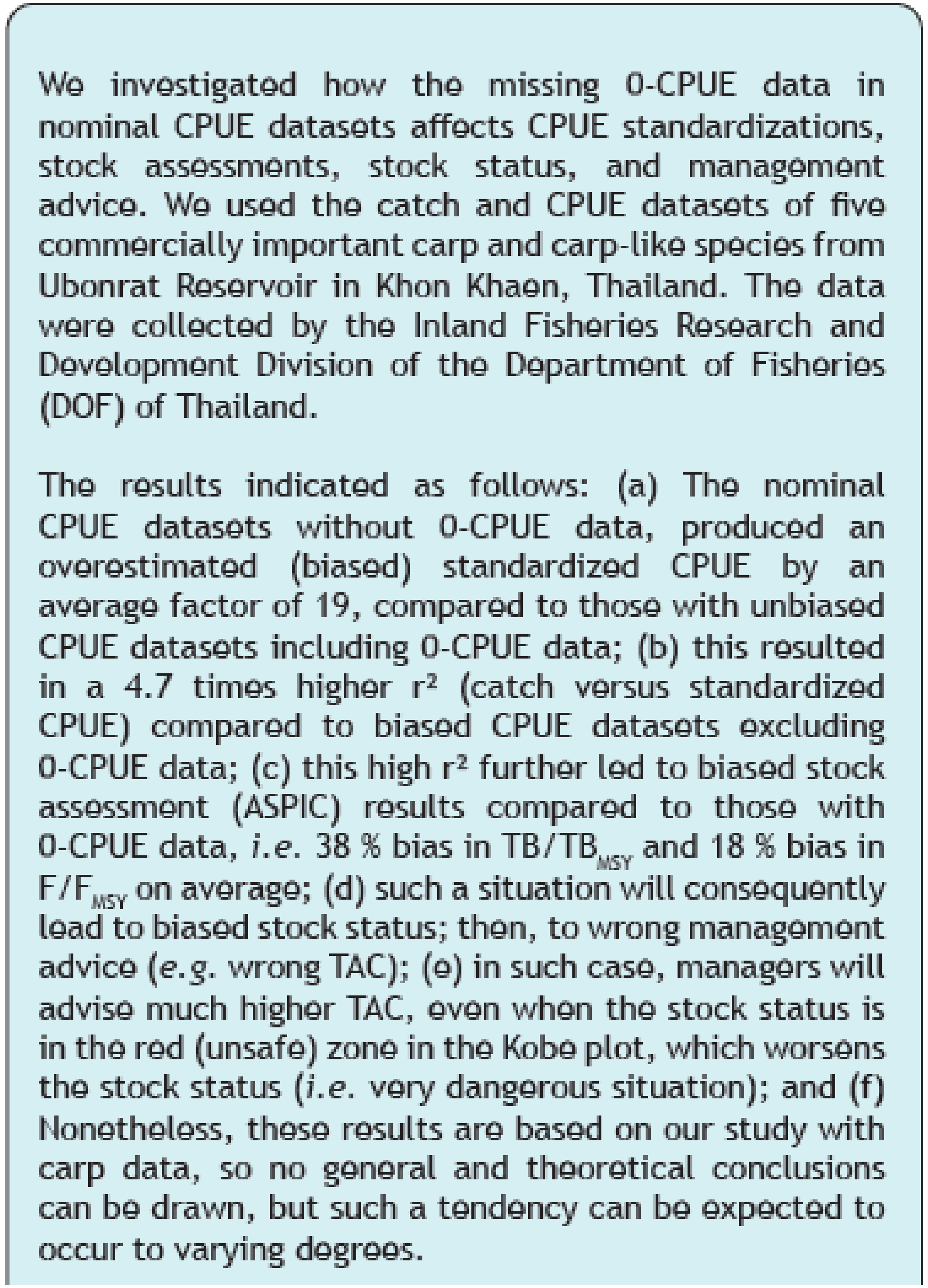
Thailand Pacific stock Gear :GILL Area: 5 (Gulf of Thailand)

year	month	date	boat name	set	catch (kg)			effort		
					King	Spanish	others	hours	hauls	days
1999	1	1	A	1	34	0	234	12	4	2
1999	1	1	A	2	0	0	566	23	4	4
2015	12	27	C	1	0	0	999	44	5	5
2015	12	27	C	2	0	0	234	23	3	4
2015	12	28	C	1	23	11	333	12	4	5

For details of missing 0 catch (CPUE), refer to Fish for the People (SEAFDEC) : Fish for the People Vol.22 No.3 (2024)

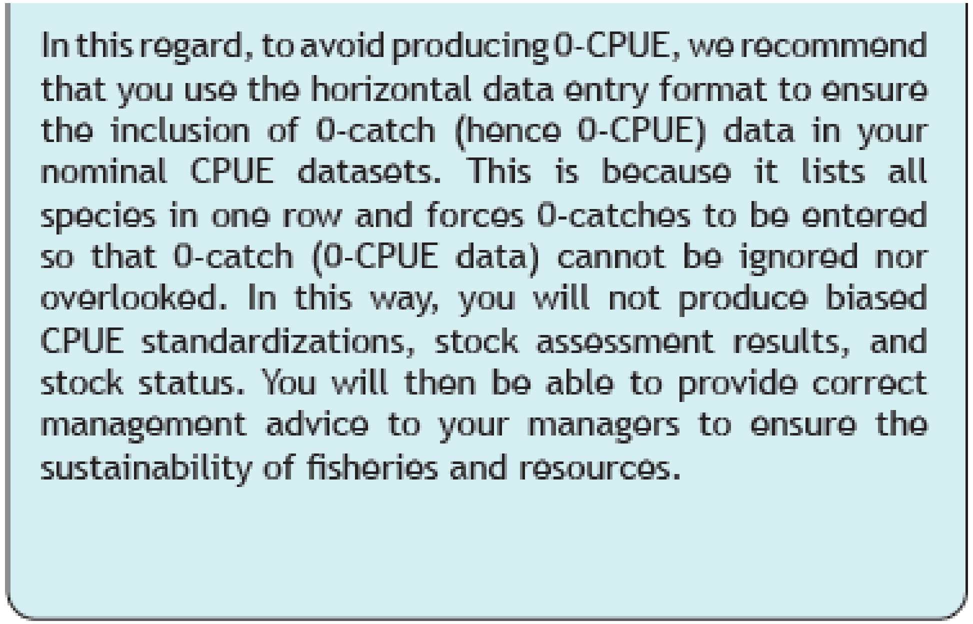
Do not forget 0-CPUE data in your CPUE standardizations to avoid wrong management advice: A case study on carp fisheries in Thailand

Tom Nishida, Wiparat Thong-ngok, Kajitpan Jaremnate, Supapong Pattarapongpan, Nipa Kulanujaree, and Weerapol Thitipongtrakul

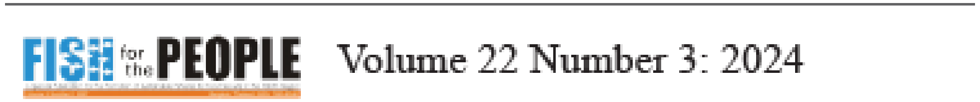


We investigated how the missing 0-CPUE data in nominal CPUE datasets affects CPUE standardizations, stock assessments, stock status, and management advice. We used the catch and CPUE datasets of five commercially important carp and carp-like species from Ubonrat Reservoir in Khon Khaen, Thailand. The data were collected by the Inland Fisheries Research and Development Division of the Department of Fisheries (DOF) of Thailand.

The results indicated as follows: (a) The nominal CPUE datasets without 0-CPUE data, produced an overestimated (biased) standardized CPUE by an average factor of 19, compared to those with unbiased CPUE datasets including 0-CPUE data; (b) this resulted in a 4.7 times higher r^2 (catch versus standardized CPUE) compared to biased CPUE datasets excluding 0-CPUE data; (c) this high r^2 further led to biased stock assessment (ASPIC) results compared to those with 0-CPUE data, *i.e.* 38 % bias in TB/TB_{MSY} and 18 % bias in F/F_{MSY} on average; (d) such a situation will consequently lead to biased stock status; then, to wrong management advice (*e.g.* wrong TAC); (e) in such case, managers will advise much higher TAC, even when the stock status is in the red (unsafe) zone in the Kobe plot, which worsens the stock status (*i.e.* very dangerous situation); and (f) Nonetheless, these results are based on our study with carp data, so no general and theoretical conclusions can be drawn, but such a tendency can be expected to occur to varying degrees.

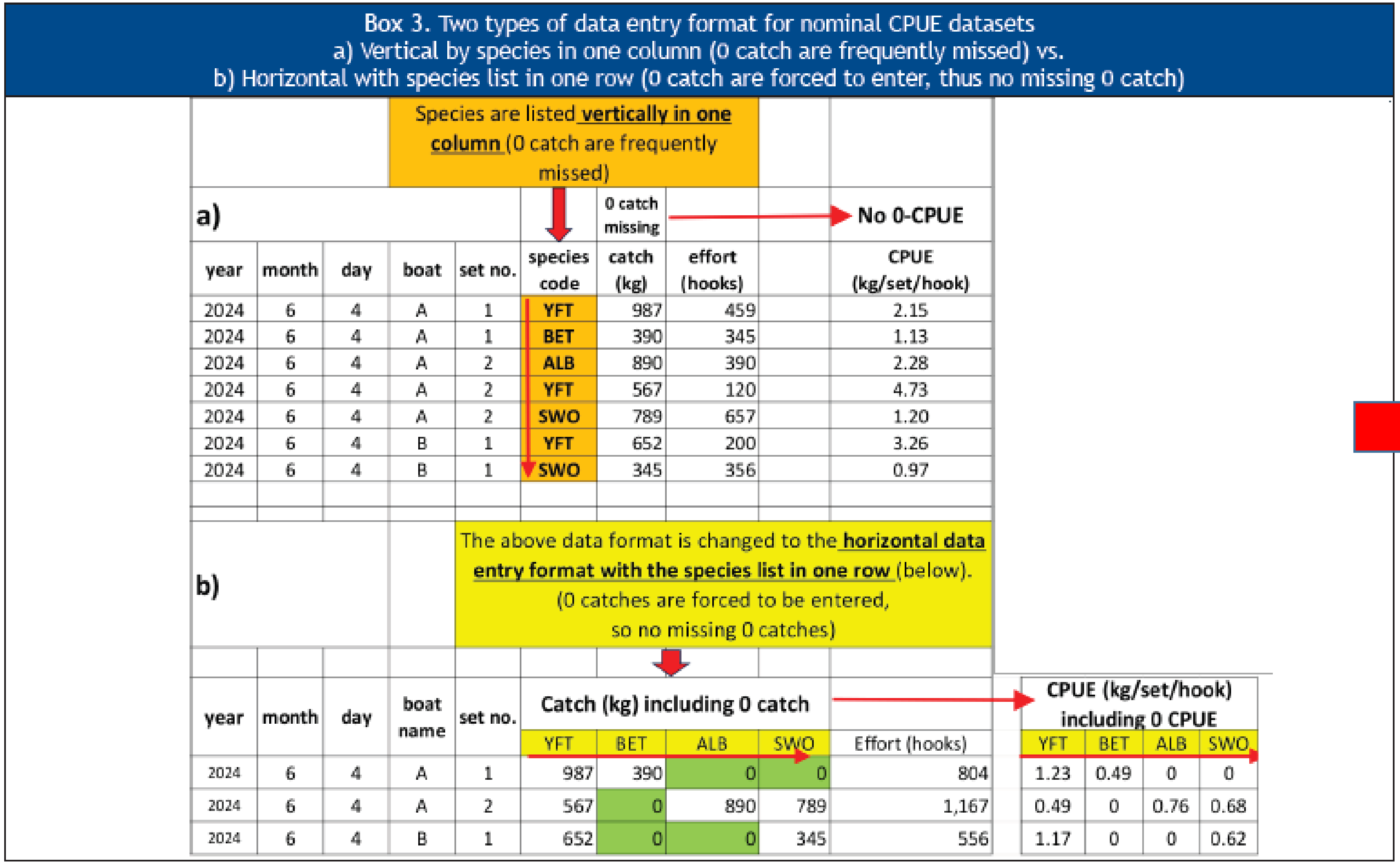


In this regard, to avoid producing 0-CPUE, we recommend that you use the horizontal data entry format to ensure the inclusion of 0-catch (hence 0-CPUE) data in your nominal CPUE datasets. This is because it lists all species in one row and forces 0-catches to be entered so that 0-catch (0-CPUE data) cannot be ignored nor overlooked. In this way, you will not produce biased CPUE standardizations, stock assessment results, and stock status. You will then be able to provide correct management advice to your managers to ensure the sustainability of fisheries and resources.



FISH for the PEOPLE Volume 22 Number 3: 2024

Continued from the previous slide



Box 3. Two types of data entry format for nominal CPUE datasets
a) Vertical by species in one column (0 catch are frequently missed) vs.
b) Horizontal with species list in one row (0 catch are forced to enter, thus no missing 0 catch)

Species are listed **vertically in one column** (0 catch are frequently missed)

a)

0 catch missing → **No 0-CPUE**

year	month	day	boat	set no.	species code	catch (kg)	effort (hooks)	CPUE (kg/set/hook)
2024	6	4	A	1	YFT	987	459	2.15
2024	6	4	A	1	BET	390	345	1.13
2024	6	4	A	2	ALB	890	390	2.28
2024	6	4	A	2	YFT	567	120	4.73
2024	6	4	A	2	SWO	789	657	1.20
2024	6	4	B	1	YFT	652	200	3.26
2024	6	4	B	1	SWO	345	356	0.97

b)

The above data format is changed to the **horizontal data entry format with the species list in one row** (below).
(0 catches are forced to be entered, so no missing 0 catches)

year	month	day	boat name	set no.	Catch (kg) including 0 catch				Effort (hooks)	CPUE (kg/set/hook) including 0 CPUE			
					YFT	BET	ALB	SWO		YFT	BET	ALB	SWO
2024	6	4	A	1	987	390	0	0	804	1.23	0.49	0	0
2024	6	4	A	2	567	0	890	789	1,167	0.49	0	0.76	0.68
2024	6	4	B	1	652	0	0	345	556	1.17	0	0	0.62

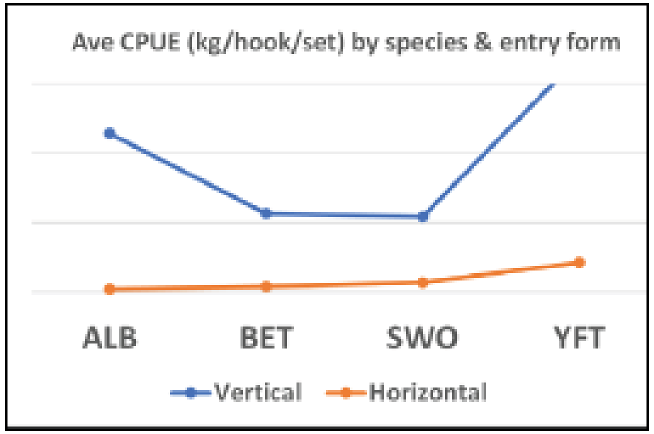


Figure 2. Average CPUE of four sample species (*i.e.* ALB, BET, SWO, and YFT) between the two data entry formats demonstrated in Box 3.

5.4 Implementing CPUE standardization

5.4 Implementing CPUE standardization: Model selection

The Table below shows the appropriate model according to 0 (zero) catch (CPUE) rate.
2 models [A] & [C] are available in this software. For [B], [C] can be used as an alternative model.
If results are NG, use [A]. If again NG, use nominal CPUE.

0 catch (CPUE) rate (%)	Model	Short name	Availability (this software)	Alternative (approximate) approach for [B]
~30%	[A] Log normal GLM	Log normal model	YES	
30%~60%	[B] Catch-Negative Binominal model	Catch model	NO	Try [C] first & if results are NG, try [A]. If still NG, use nominal CPUE.
60%~	[C]Zero inflated Delta 2 steps log normal GLM (*)	Delta model	YES	

(*) Tweedie model or Zero inflated Poisson/Negative binominal model can be also applied.

What is the [C] Delta model (Zero inflated Delta 2 steps log normal GLM)

The delta-lognormal model is a two-step process in which the probability of CPUE being non-zero (i.e. the probability of being caught) is estimated using a logit model, and then the lognormal model is applied to the non-zero portion only to estimate CPUE, and the two results are multiplied together to estimate the standardized CPUE.

Formula of 2 models [A] & [C]

*See page 63 about the interaction terms (why only Season*Area?)*

[A] Log normal GLM

log (CPUE + Constant) =Intercept + Year + Season + Area + Season*Area

Categorical data + Other covariates (Max 3) + Error ~ $N(0, \sigma^2)$

*See next page about Constant (0.1*average of nominal CPUE)*

[C] Delta 2 steps log normal model

1st step (delta model using logit model)

E [log{q/(1-q)}] =intercept + Year + Season + Area + Season*Area

Categorical data + Other covariates (Max) ,where q(ratio of zero-CPUE)~Binominal (θ)

2nd step (log normal model for non 0 CPUE)

log(CPUE)=Intercept + Year + Season + Area + Season*Area

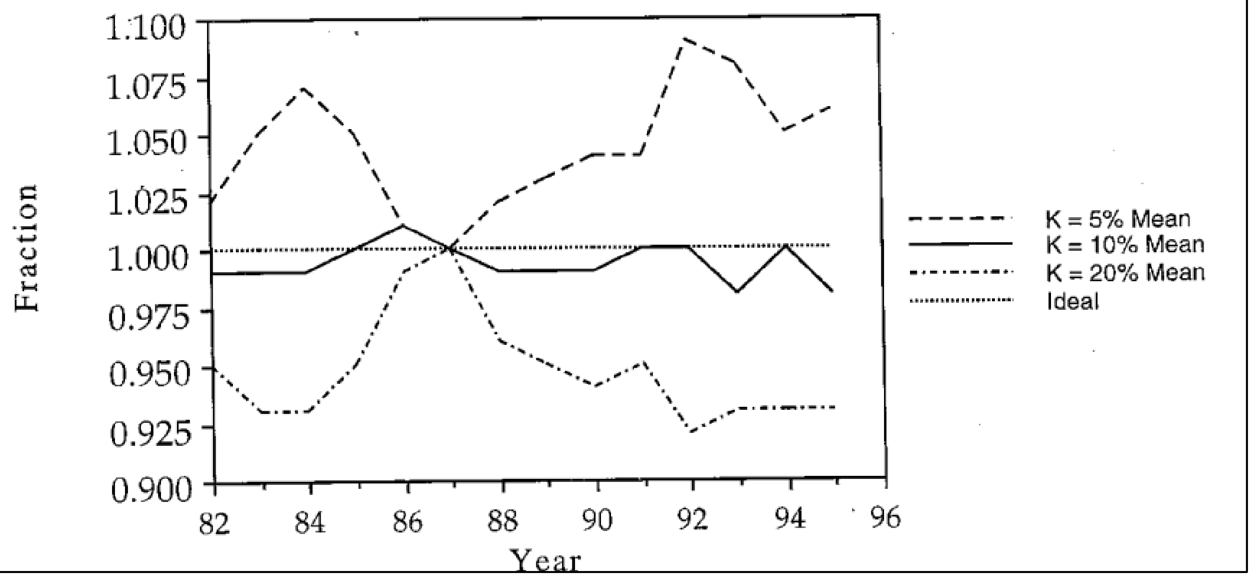
Categorical data + Other covariates (Max 3) + Error ~ $N(0, \sigma^2)$

What is the Constant in log normal GLM?

It is 10% of average nominal CPUE based on the study
“Indices of abundance for Southern Bluefin tuna
from analyses of Fins-scale Catch & Effort Data”
by Campbell, Tuck, Nishida & Tsuji (1996) (CCSBT/SC/96/16)

Based on the simulation study, 10% produce the least biased abundance index

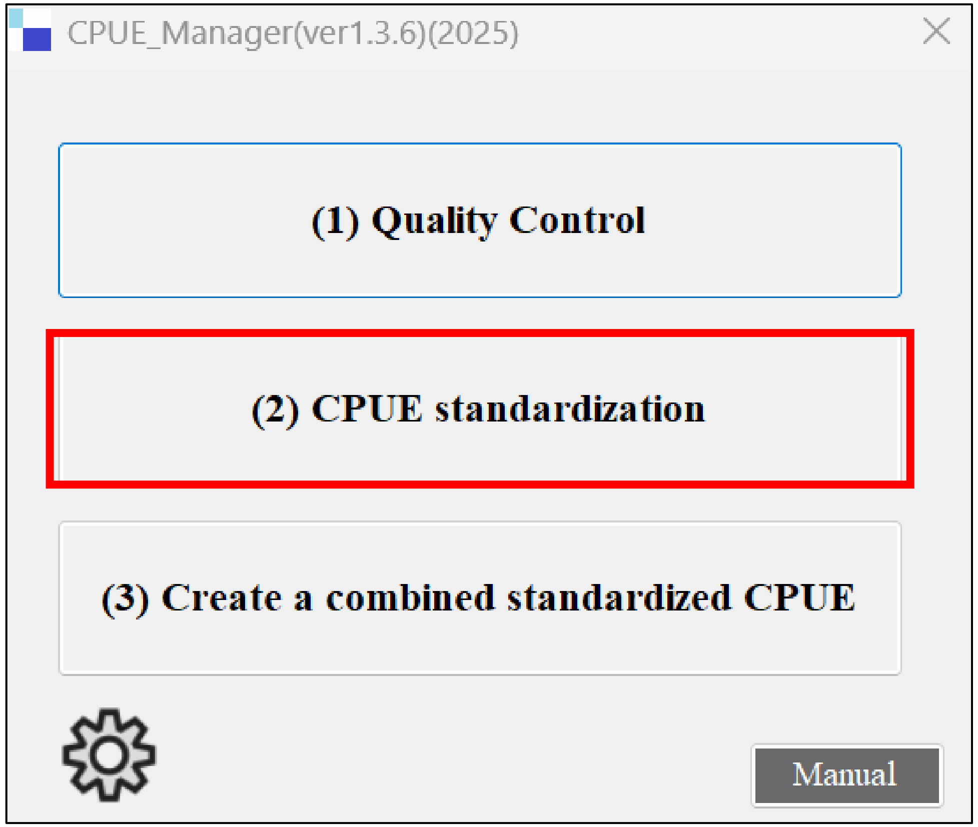
Figure A1 Comparison of the ratio of the estimated relative indices of abundance with the true relative indices for various values of K used in the estimation procedure.



5.4.1 Implementing CPUE standardization

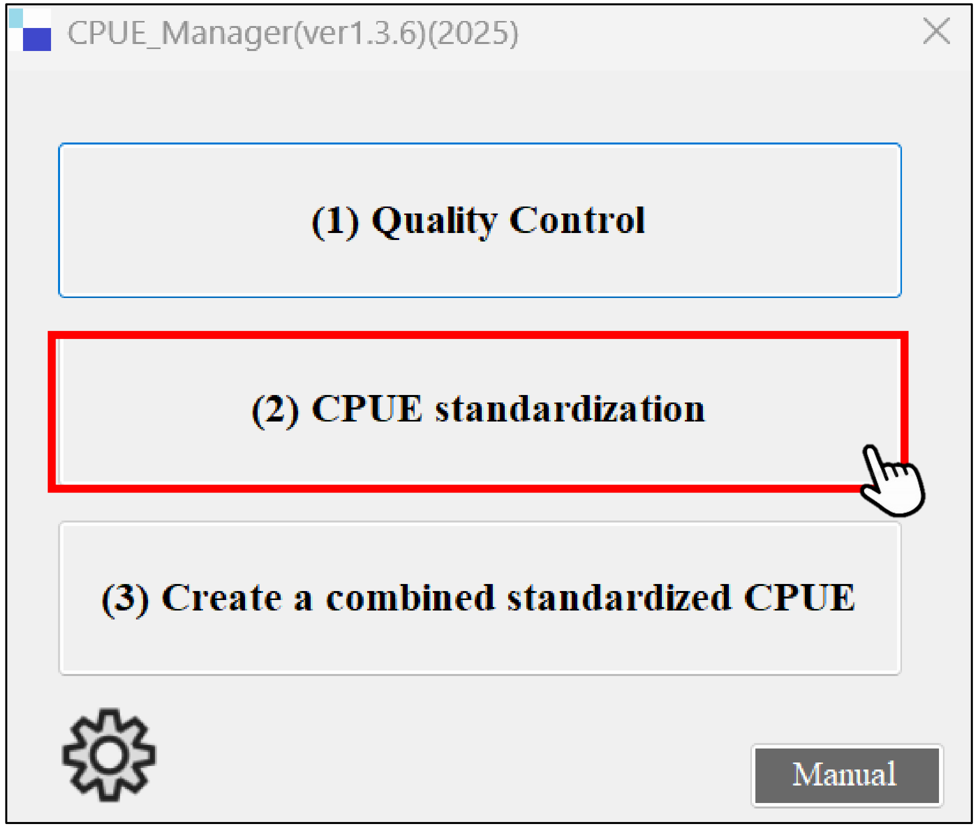
Log normal GLM: Outline

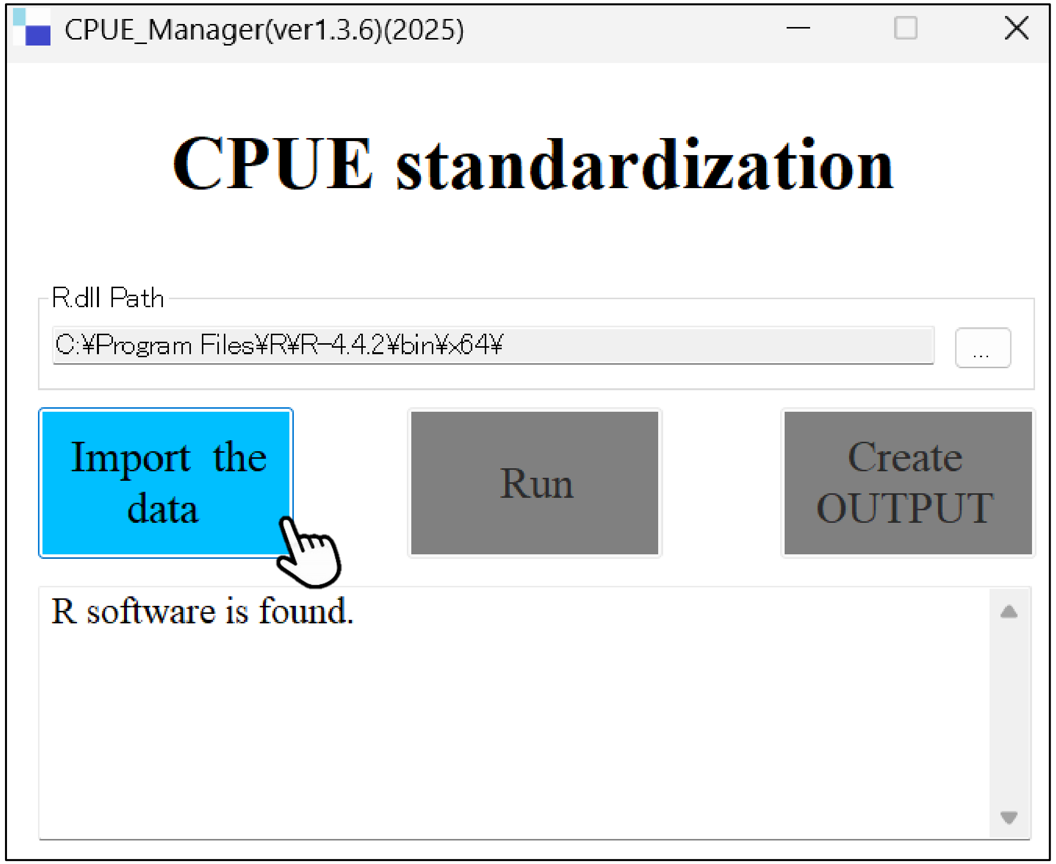
5.4.1 Implementing CPUE standardization log normal GLM



5.4.1 Implementing CPUE standardization (log normal GLM)

Importing the nominal CPUE data set

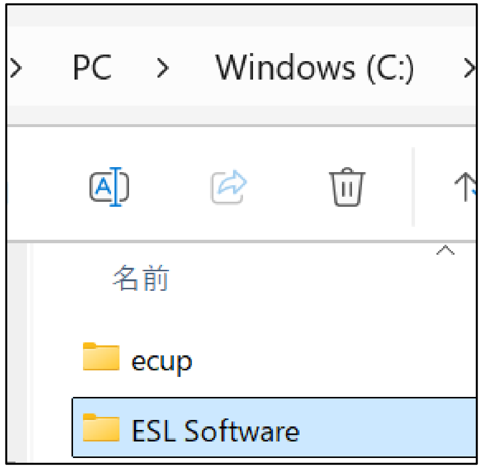




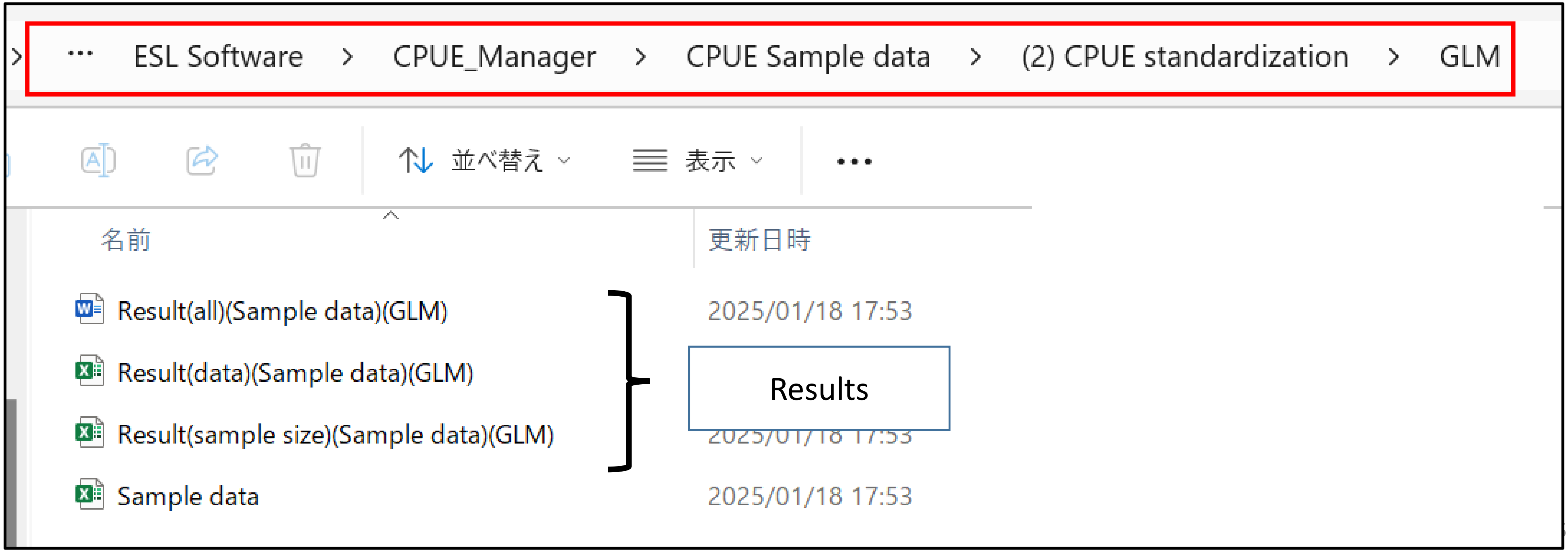
R.dll Path: C:¥Program Files¥R¥R-4.4.2¥bin¥x64¥

R software is found.

5.4.1 Implementing CPUE standardization (Log normal GLM)
Importing the nominal CPUE data set ➔ Sample



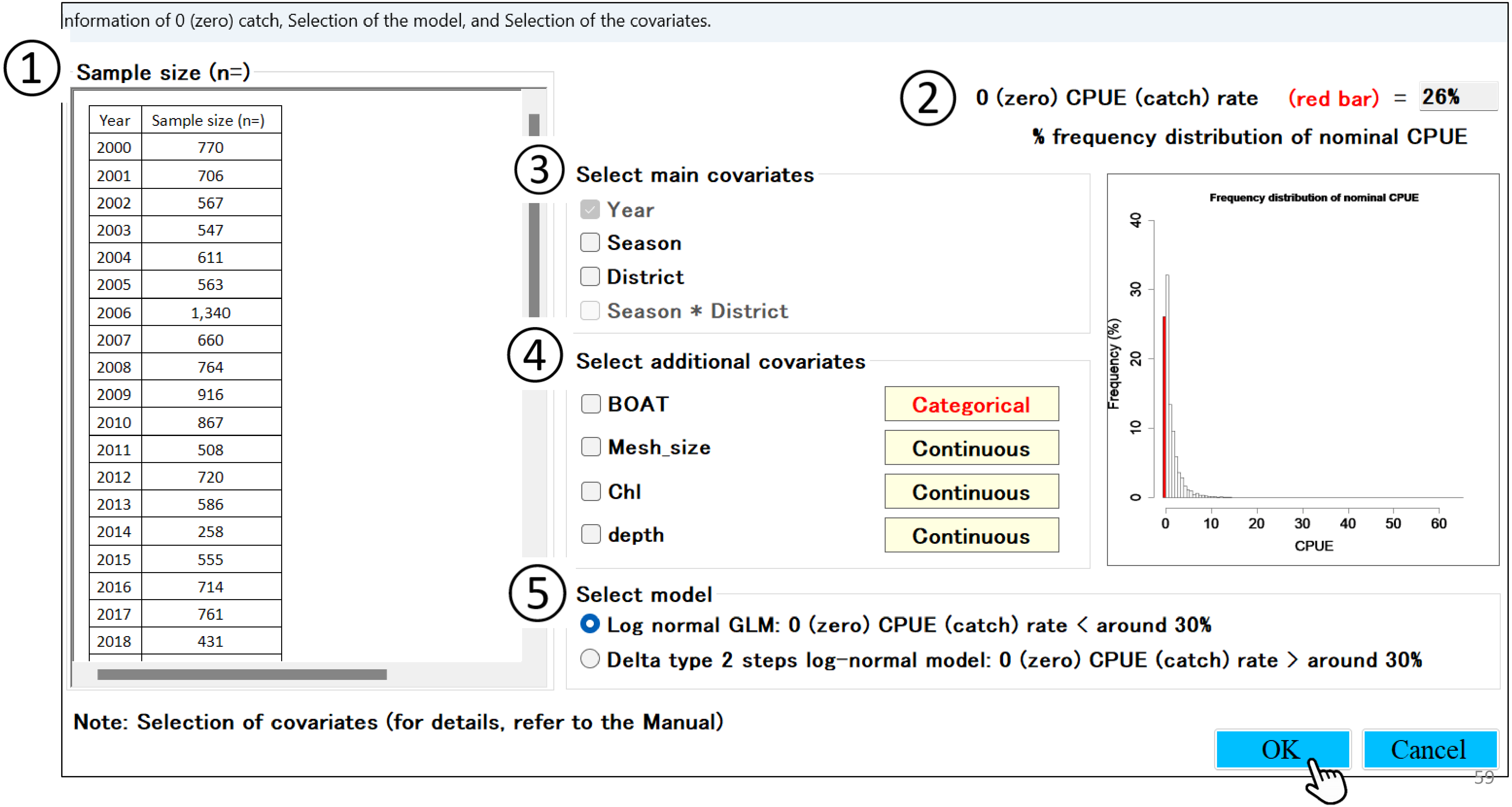
ecup
ESL Software



Result(all)(Sample data)(GLM) 2025/01/18 17:53
Result(data)(Sample data)(GLM)
Result(sample size)(Sample data)(GLM) 2025/01/18 17:53
Sample data 2025/01/18 17:53

Results

5.4.1 Implementing CPUE standardization (log normal GLM): 1st window



nformation of 0 (zero) catch, Selection of the model, and Selection of the covariates.

① **Sample size (n=)**

Year	Sample size (n=)
2000	770
2001	706
2002	567
2003	547
2004	611
2005	563
2006	1,340
2007	660
2008	764
2009	916
2010	867
2011	508
2012	720
2013	586
2014	258
2015	555
2016	714
2017	761
2018	431

② 0 (zero) CPUE (catch) rate (red bar) = 26%

% frequency distribution of nominal CPUE

③ **Select main covariates**

- ☑ Year
- ☐ Season
- ☐ District
- ☐ Season * District

④ **Select additional covariates**

☐ BOAT	Categorical
☐ Mesh_size	Continuous
☐ Chl	Continuous
☐ depth	Continuous

⑤ **Select model**

- ● Log normal GLM: 0 (zero) CPUE (catch) rate < around 30%
- ○ Delta type 2 steps log-normal model: 0 (zero) CPUE (catch) rate > around 30%

Note: Selection of covariates (for details, refer to the Manual)

5.4.1 Implementing CPUE standardization (log normal GLM)

① Sample size (n=)

If sample size (covariates & nominal CPUE) is not enough (n < 10),
follow suggestions as below:

If number of years < 10

➔ Better not conduct “CPUE standardization” nor “ stock assessment”

as not enough # of years ➔ produce unreliable results

If year(n)≥ 10 and n < 10 (Season, area & one categorical data)

➔ Delete or Change to larger category as examples below:

If # of data in some month < 10 ➔ Change to Quarter

If # of data in some areas (5 areas) <10 ➔ change to 3 areas

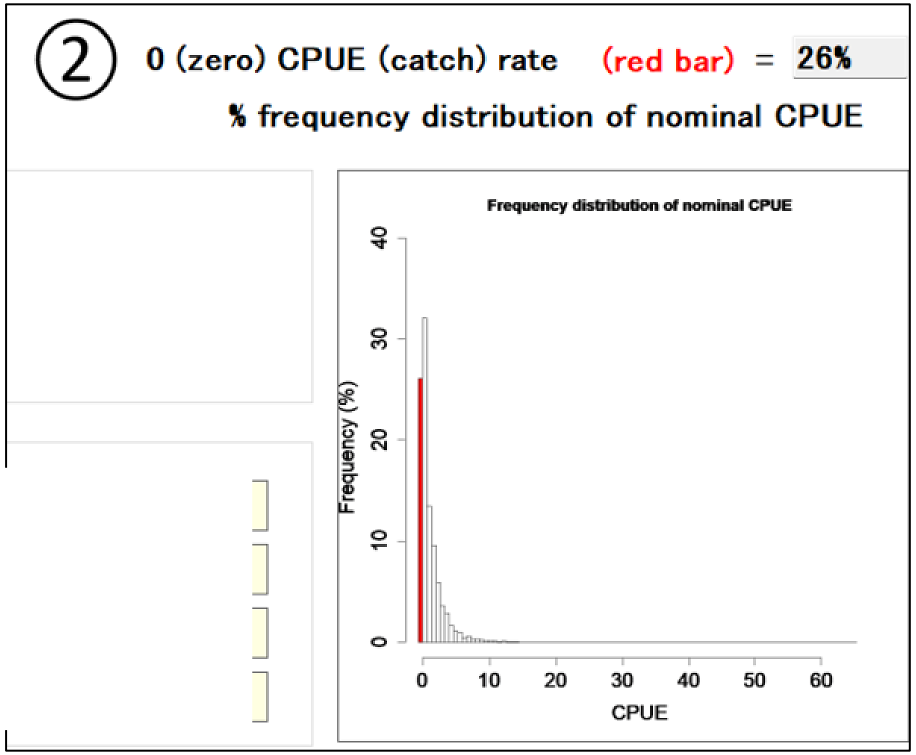
If some class (5 boat class)< 10 ➔ change to 3 classes

so that enough sample sizes can be secured.

# of data (3 continuous covariates) < 10, delete & do not use.

5.4.1 Implementing CPUE standardization (log normal GLM)

② **0 (zero) catch (CPUE) rate**



② 0 (zero) CPUE (catch) rate (red bar) = 26%

% frequency distribution of nominal CPUE

Red bar (% frequency distribution)

(in the nominal CPUE data set)

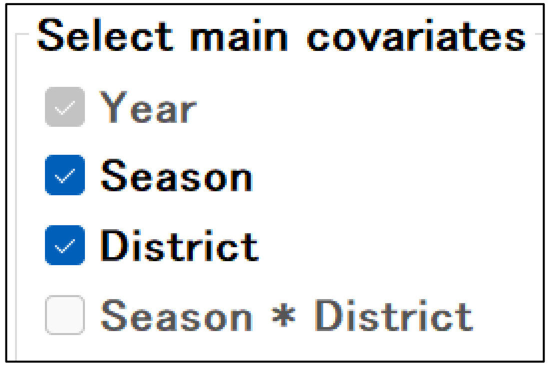
0 catch (CPUE) rate

To be utilized in ⑤ (model selection).

In this case, 0 catch rate=26%

5.4.1 Implementing CPUE standardization (log normal GLM)

③ Selection of main (core) covariates (1/3)



Select main covariates

- ☑ Year
- ☑ Season
- ☑ District
- ☐ Season * District

3 main (core) covariates

→Year, Season (month, quarter, etc.) & area (District, fishing grounds, etc.)

Users can select interaction (Season*District) if no missing data.

In the example (left), it is masked due to missing values in either Season or District.

Please see next pager, the reason why other interaction are not needed.

Please enter check marks ☑ if you have Covariates.

Y(year) is the essential covariate to estimate annual CPUE standardization

If users have missing years, ignore them and enter only available years.

Then standardized CPUE will be made by skipping missing years.

5.4.1 Implementing CPUE standardization(log normal GLM)

③ Selection of main (core) covariates (2/3)

Y(year) related interaction (e.g., year*month & year*area) ➔ NO need
Because interpretations are difficult due to complex situation
(see 2 reference papers).

Hinton & Maunder (2004) ➔ invalid

⇩

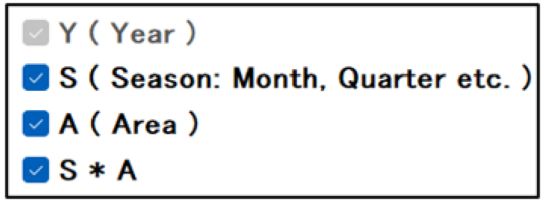
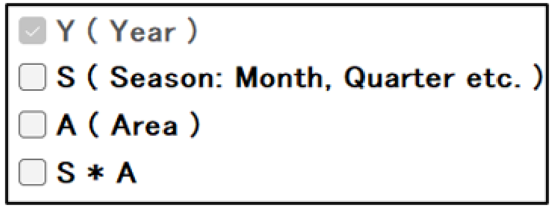
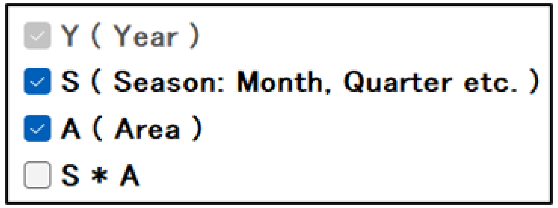
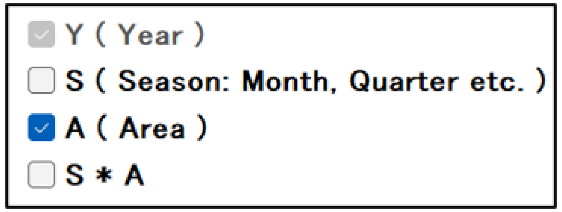
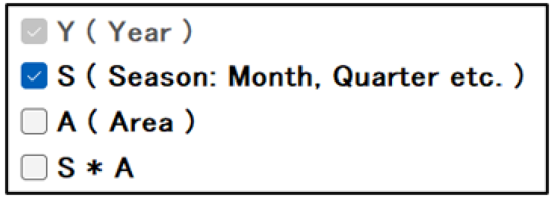
Maunder & Punt (2004)
Identifying significant interactions with year
➔ no need (impossible to explain)

5.4.1
Implementing CPUE standardization
log normal GLM
③ **Selection of main (core) covariates (3/3)**

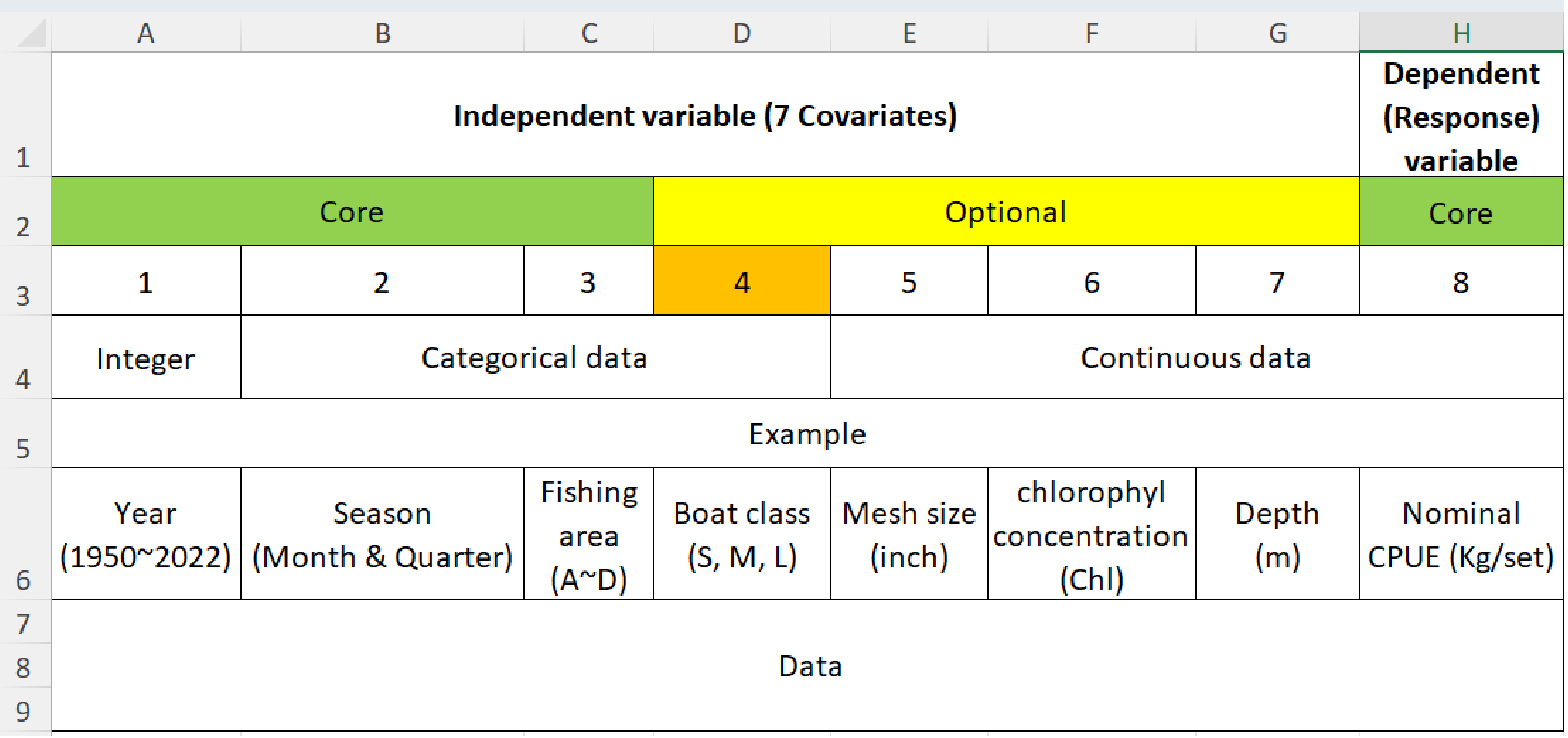
Selection of covariates according to the situation of missing values using season & area (example)

Y(year) ➔ Always selected (masked)
(to estimate annual standardized CPUE)

If users have other covariate names (e.g., mesh size, boat size), the same are applied.

Missing values		Selection of Covariates	
Season	Area		
no	no	 ☑ Y (Year) ☑ S (Season: Month, Quarter etc.) ☑ A (Area) ☑ S ＊ A	
all	all	 ☑ Y (Year) ☐ S (Season: Month, Quarter etc.) ☐ A (Area) ☐ S ＊ A	*(only year is used)*
some	some	 ☑ Y (Year) ☑ S (Season: Month, Quarter etc.) ☑ A (Area) ☐ S ＊ A	
all	some	 ☑ Y (Year) ☐ S (Season: Month, Quarter etc.) ☑ A (Area) ☐ S ＊ A	
some	all	 ☑ Y (Year) ☑ S (Season: Month, Quarter etc.) ☐ A (Area) ☐ S ＊ A	

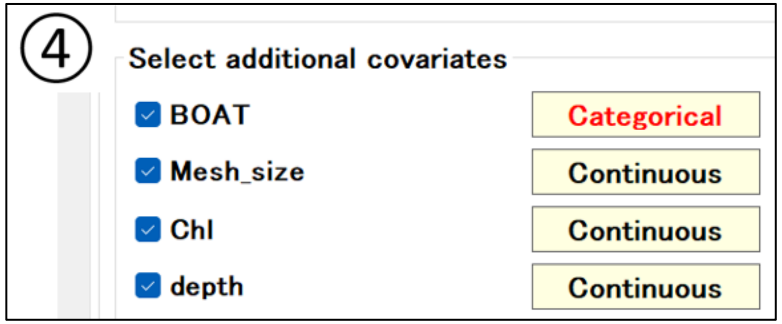
IM で使った　continuous カテゴリカルデータ　表を使用



	A	B	C	D	E	F	G	H
1	**Independent variable (7 Covariates)**							**Dependent (Response) variable**
2	Core			Optional				Core
3	1	2	3	4	5	6	7	8
4	Integer	Categorical data			Continuous data			
5	Example							
6	Year (1950~2022)	Season (Month & Quarter)	Fishing area (A~D)	Boat class (S, M, L)	Mesh size (inch)	chlorophyl concentration (Chl)	Depth (m)	Nominal CPUE (Kg/set)
7	Data							
8								
9								

5.4.1 Implementing CPUE standardization: Log normal GLM

④ Selection : Additional 4 covariates (option)



④

Select additional covariates

☑ BOAT	Categorical
☑ Mesh_size	Continuous
☑ Chl	Continuous
☑ depth	Continuous

There are 4 additional (optional) Covariates

● 1 for categorical data

Examples Boat class (small, medium, large)

Skipper's skill (normal, good, excellent)

● 3 for continuous data

Examples Environmental data (temperature, salinity, depth, etc.)

Mesh size, etc.

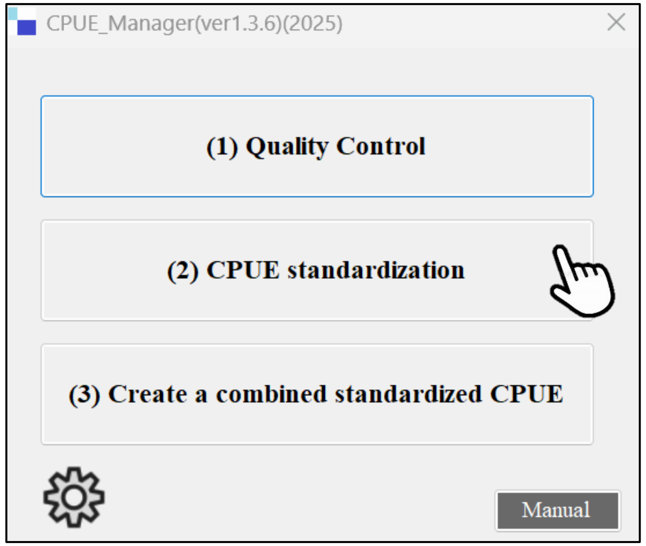
→ If users have such data, enter check mark ☑

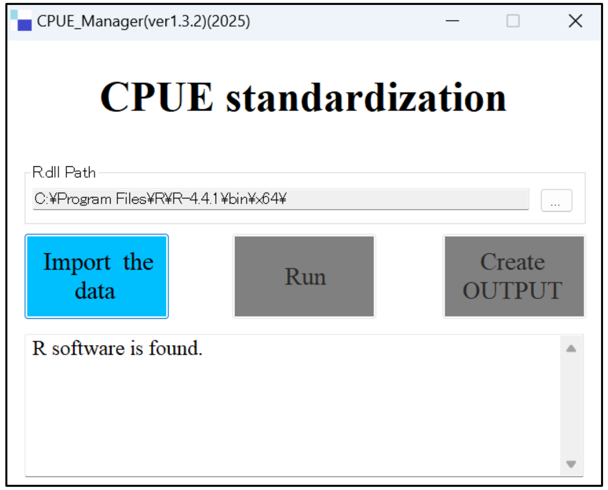
5.4.1 Implementing CPUE standardization (log normal GLM)

⑤ Log normal GLM model is automatically selected if 0 catch(CPUE) rate < 30%

5.4.1 Implementing CPUE standardization (log normal GLM)

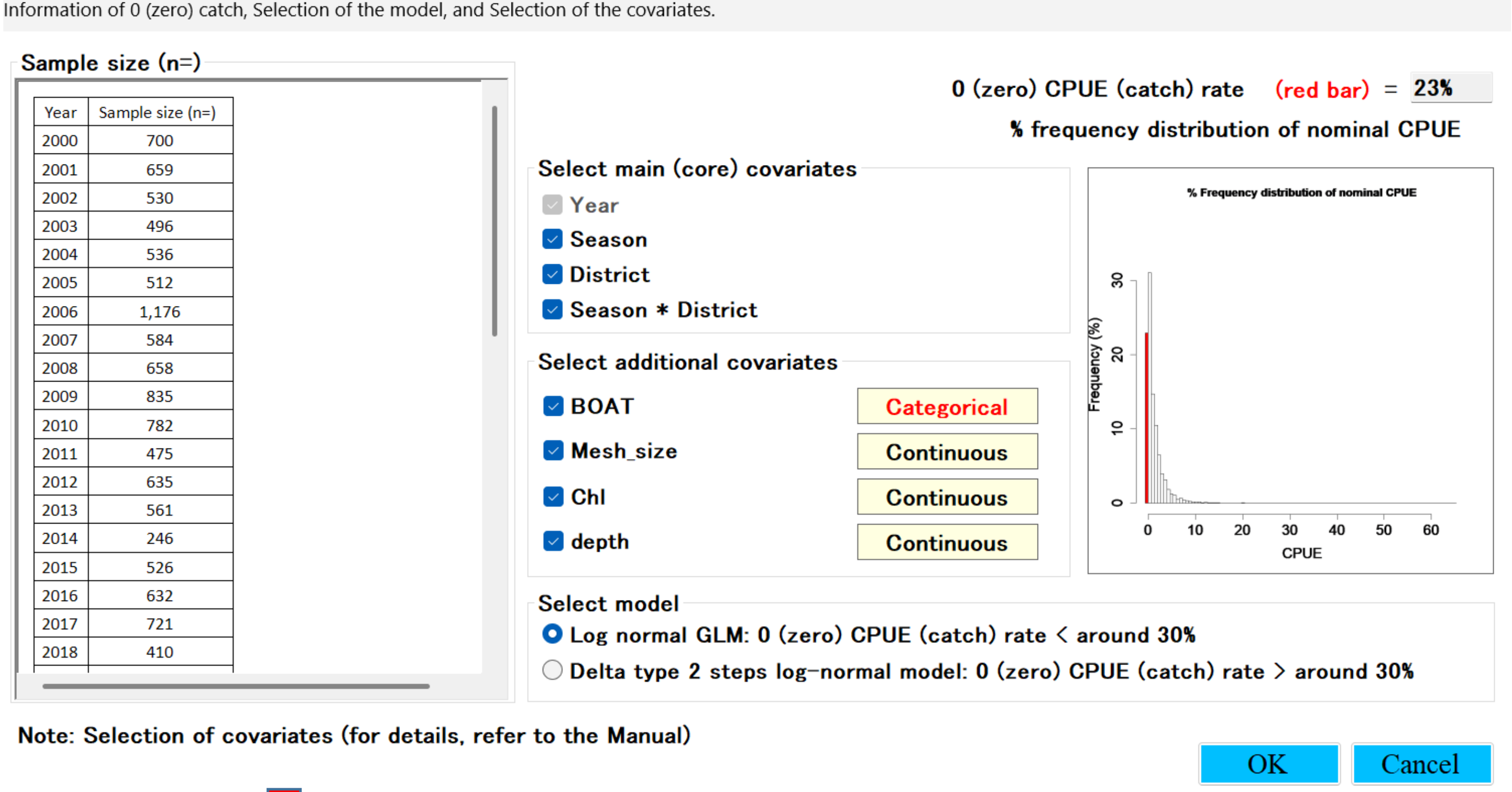
Summary





R.dll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

R software is found.


Information of 0 (zero) catch, Selection of the model, and Selection of the covariates.

Sample size (n=)

Year	Sample size (n=)
2000	700
2001	659
2002	530
2003	496
2004	536
2005	512
2006	1,176
2007	584
2008	658
2009	835
2010	782
2011	475
2012	635
2013	561
2014	246
2015	526
2016	632
2017	721
2018	410

0 (zero) CPUE (catch) rate (red bar) = 23%

% frequency distribution of nominal CPUE

Select main (core) covariates

☑ Year
☑ Season
☑ District
☑ Season * District

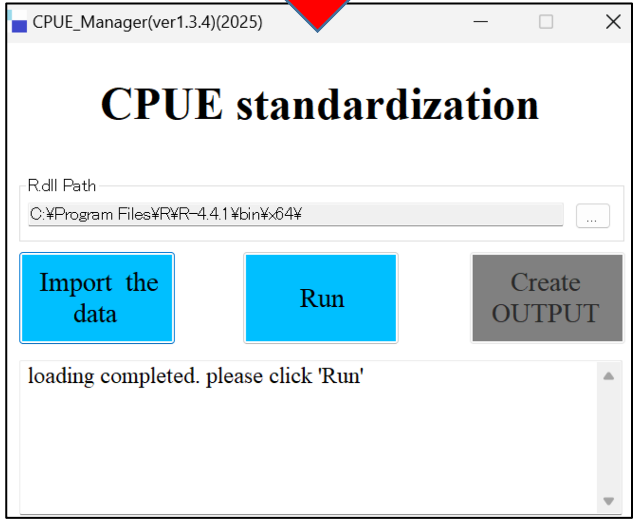
Select additional covariates

☑ BOAT — Categorical
☑ Mesh_size — Continuous
☑ Chl — Continuous
☑ depth — Continuous

Select model

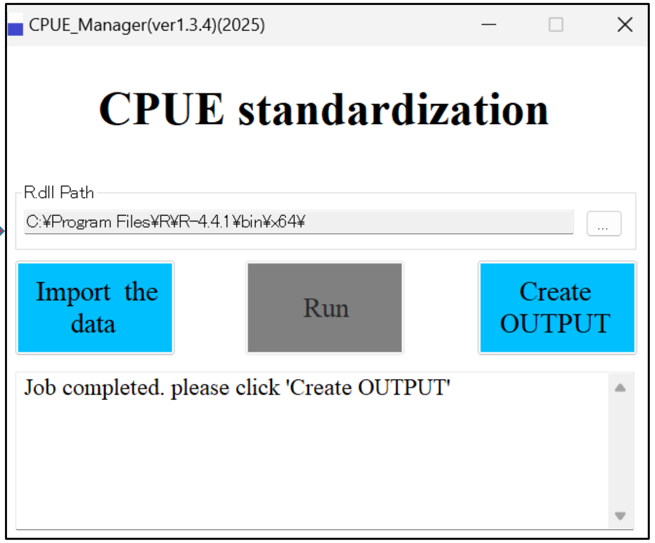
● Log normal GLM: 0 (zero) CPUE (catch) rate < around 30%
○ Delta type 2 steps log-normal model: 0 (zero) CPUE (catch) rate > around 30%

Note: Selection of covariates (for details, refer to the Manual)



R.dll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

loading completed. please click 'Run'



R.dll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

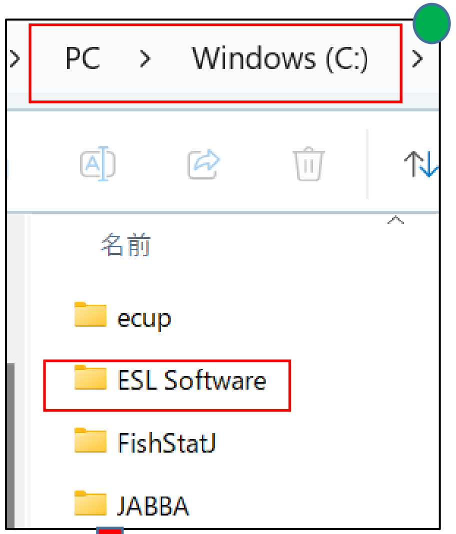
Job completed. please click 'Create OUTPUT'

5.4.1 Implementing CPUE standardization (log normal GLM)

Output

5.4.1 Implementing CPUE standardization (log normal GLM)

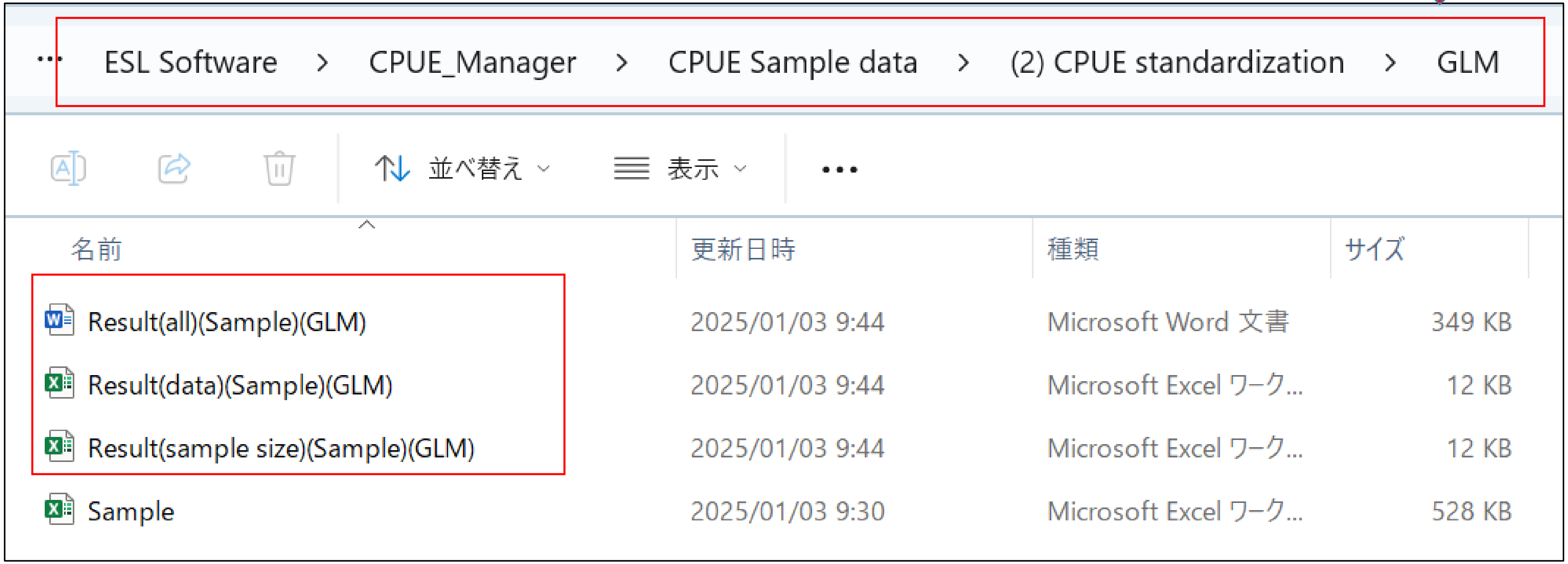
Results folders & files for sample data are available in ESL software folder



PC > Windows (C:) >

名前

- ecup
- ESL Software
- FishStatJ
- JABBA



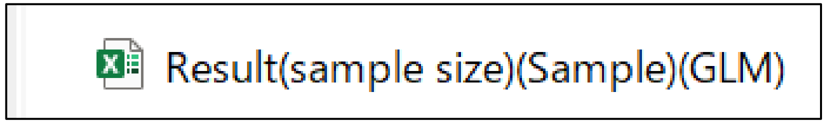
… ESL Software > CPUE_Manager > CPUE Sample data > (2) CPUE standardization > GLM

名前	更新日時	種類	サイズ
Result(all)(Sample)(GLM)	2025/01/03 9:44	Microsoft Word 文書	349 KB
Result(data)(Sample)(GLM)	2025/01/03 9:44	Microsoft Excel ワーク...	12 KB
Result(sample size)(Sample)(GLM)	2025/01/03 9:44	Microsoft Excel ワーク...	12 KB
Sample	2025/01/03 9:30	Microsoft Excel ワーク...	528 KB

5.4.1 Implementing CPUE standardization(log normal GLM):OUTPUT

Output file #	Results	Contents	Type	File name
(1)	① Sample size of covariates	Year, season, area, and interaction (season*area)	Data	Result(sample size)(Sample)(GLM)
(2)	① Standardized CPUE (Original scale)	Standardized CPUE and 95% CI with nominal CPUE		Result(data)(Sample)(GLM)
	② Standardized CPUE (Scaled as average values =1)			
(3)	① 0 (zero) catch rate	% freq. distribution of nominal CPUE with 0 catch rate	Graphs	Result(all)(Sample)(GLM)
	② ANOVA Table (Analyses Of Variances)	Statistical test for model & covariates	Table	
	③ Standardized CPUE Real values and Scaled (Average values =1)	Standardized CPUE and 95% CI with nominal CPUE	Graphs	
	④ Residual analyses Histogram and QQ (Quantile-Quantile) plot	To test suitability of GLM using the error distribution		

5.4.1 Implementing CPUE standardization (log normal GLM):OUTPUT
(1) Sample size (Covariates) **(partial outputs)**



Excel sheets for output.

Year	Sample size (n=)
2000	770
2001	706
2002	567
2003	547
2004	611
2005	563
2006	1,340
2007	660
2008	764
2009	916
2010	867
2011	508
2012	720
2013	586
2014	258
2015	555
2016	714
2017	761
2018	431
2019	584
2020	138
2021	240

Season	Sample size (n=)
IM1	1,741
IM2	2,505
NE	3,185
SW	6,375

District	Sample size (n=)
Chilaw	5,832
Kalutara	2,095
Matara	1,413
Negombo	4,466

BOAT	Sample size (n=)
L	3,678
M	6,946
S	3,182

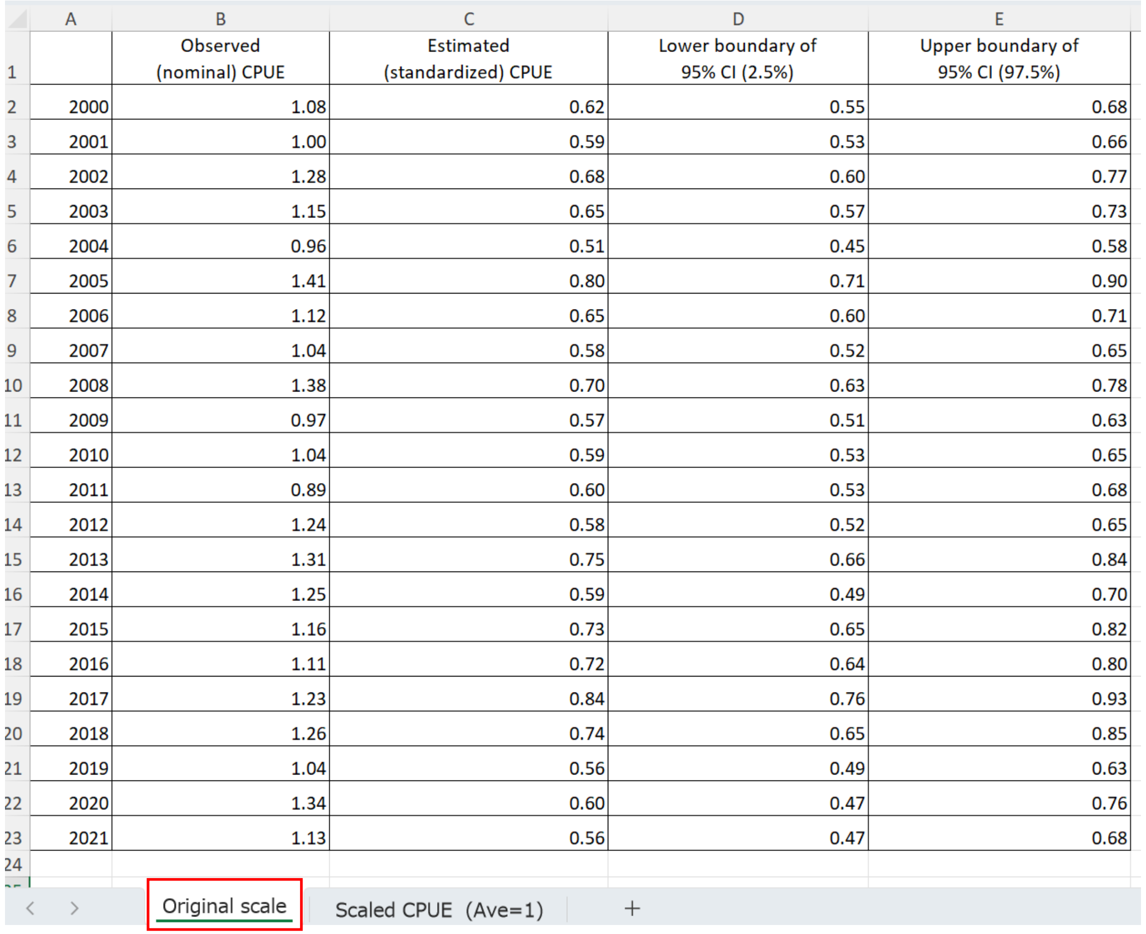
Season*District	Sample size(n=)			
	District			
Season	Chilaw	Kalutara	Matara	Negombo
IM1	742	166	209	624
IM2	701	972	37	795
NE	1,682	171	47	1,285
SW	2,707	786	1,120	1,762

5.4.1 Implementing CPU standardization(log normal GLM): Output

Result(data)(Sample)(GLM)

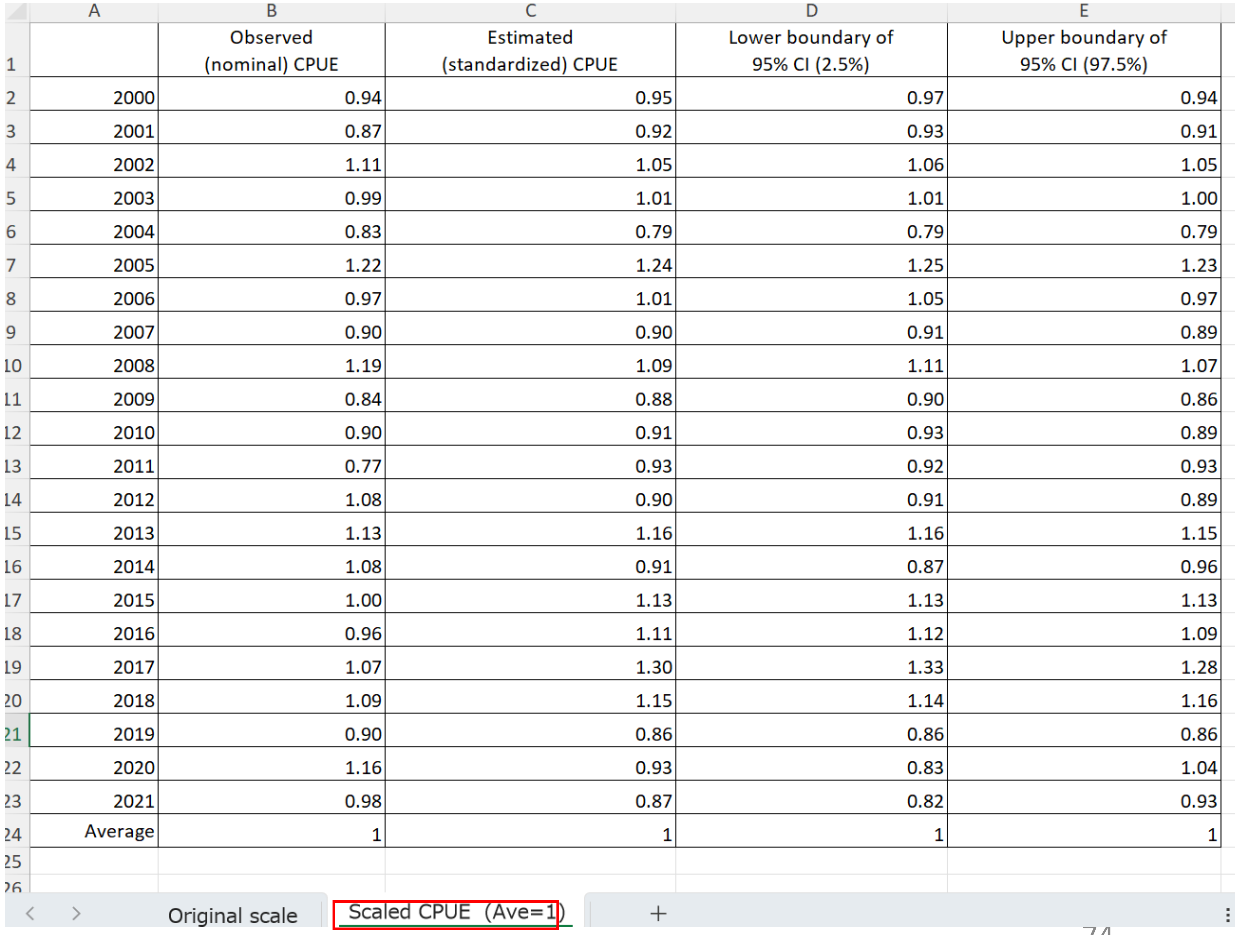
(2) Standardized CPUE with its 95% CI (Confidence Intervals) & nominal CPUE (results in 2 excel sheets)

Original scale



	Observed (nominal) CPUE	Estimated (standardized) CPUE	Lower boundary of 95% CI (2.5%)	Upper boundary of 95% CI (97.5%)
2000	1.08	0.62	0.55	0.68
2001	1.00	0.59	0.53	0.66
2002	1.28	0.68	0.60	0.77
2003	1.15	0.65	0.57	0.73
2004	0.96	0.51	0.45	0.58
2005	1.41	0.80	0.71	0.90
2006	1.12	0.65	0.60	0.71
2007	1.04	0.58	0.52	0.65
2008	1.38	0.70	0.63	0.78
2009	0.97	0.57	0.51	0.63
2010	1.04	0.59	0.53	0.65
2011	0.89	0.60	0.53	0.68
2012	1.24	0.58	0.52	0.65
2013	1.31	0.75	0.66	0.84
2014	1.25	0.59	0.49	0.70
2015	1.16	0.73	0.65	0.82
2016	1.11	0.72	0.64	0.80
2017	1.23	0.84	0.76	0.93
2018	1.26	0.74	0.65	0.85
2019	1.04	0.56	0.49	0.63
2020	1.34	0.60	0.47	0.76
2021	1.13	0.56	0.47	0.68

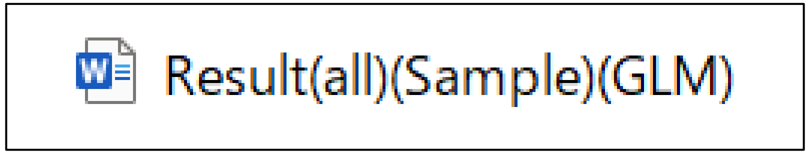
Scaled as Ave=1



	Observed (nominal) CPUE	Estimated (standardized) CPUE	Lower boundary of 95% CI (2.5%)	Upper boundary of 95% CI (97.5%)
2000	0.94	0.95	0.97	0.94
2001	0.87	0.92	0.93	0.91
2002	1.11	1.05	1.06	1.05
2003	0.99	1.01	1.01	1.00
2004	0.83	0.79	0.79	0.79
2005	1.22	1.24	1.25	1.23
2006	0.97	1.01	1.05	0.97
2007	0.90	0.90	0.91	0.89
2008	1.19	1.09	1.11	1.07
2009	0.84	0.88	0.90	0.86
2010	0.90	0.91	0.93	0.89
2011	0.77	0.93	0.92	0.93
2012	1.08	0.90	0.91	0.89
2013	1.13	1.16	1.16	1.15
2014	1.08	0.91	0.87	0.96
2015	1.00	1.13	1.13	1.13
2016	0.96	1.11	1.12	1.09
2017	1.07	1.30	1.33	1.28
2018	1.09	1.15	1.14	1.16
2019	0.90	0.86	0.86	0.86
2020	1.16	0.93	0.83	1.04
2021	0.98	0.87	0.82	0.93
Average	1	1	1	1

5.4.1 Implementing CPUE standardization (log normal GLM)

(3) Output : Report (word) file



Result(all)(Sample)(GLM)

① % frequency distribution of 0 (zero) catch (CPUE) and % of 0 catch (CPUE)

② ANOVA (Analysis Of Variance) Table

③ Trends of 4 annual CPUE (nominal, standardized and its 95% CI)

④ Evaluation of log normal GLM model

(2 Residual analyses by histogram and QQ plots)

5.4.1 Implementing CPUE standardization (log normal GLM)

(3) Output : Report (word) file

①

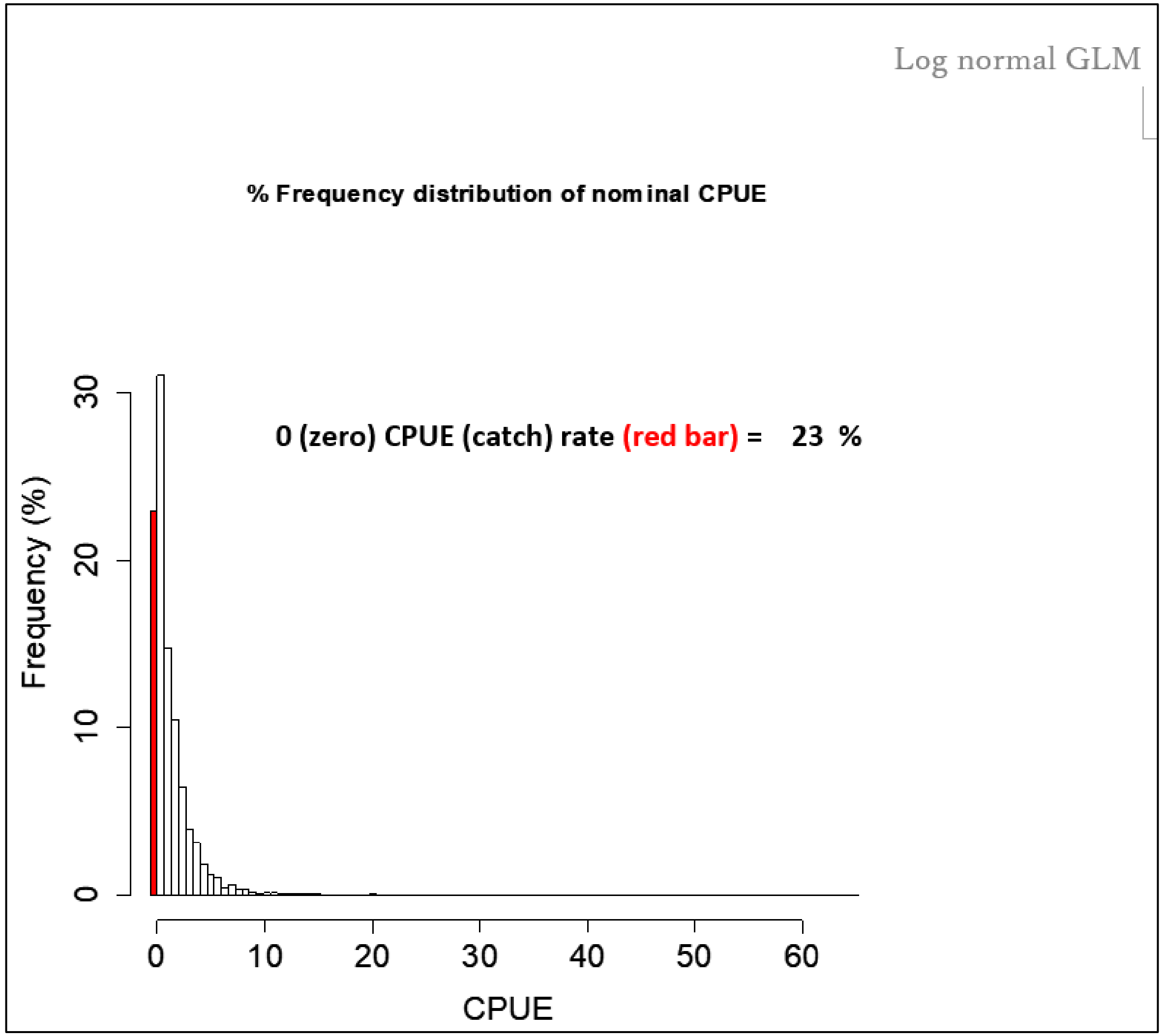
% frequency distribution of nominal CPUE

Red bar

↓

0 CPUE (catch) rate

if < 30%, use log normal GLM model



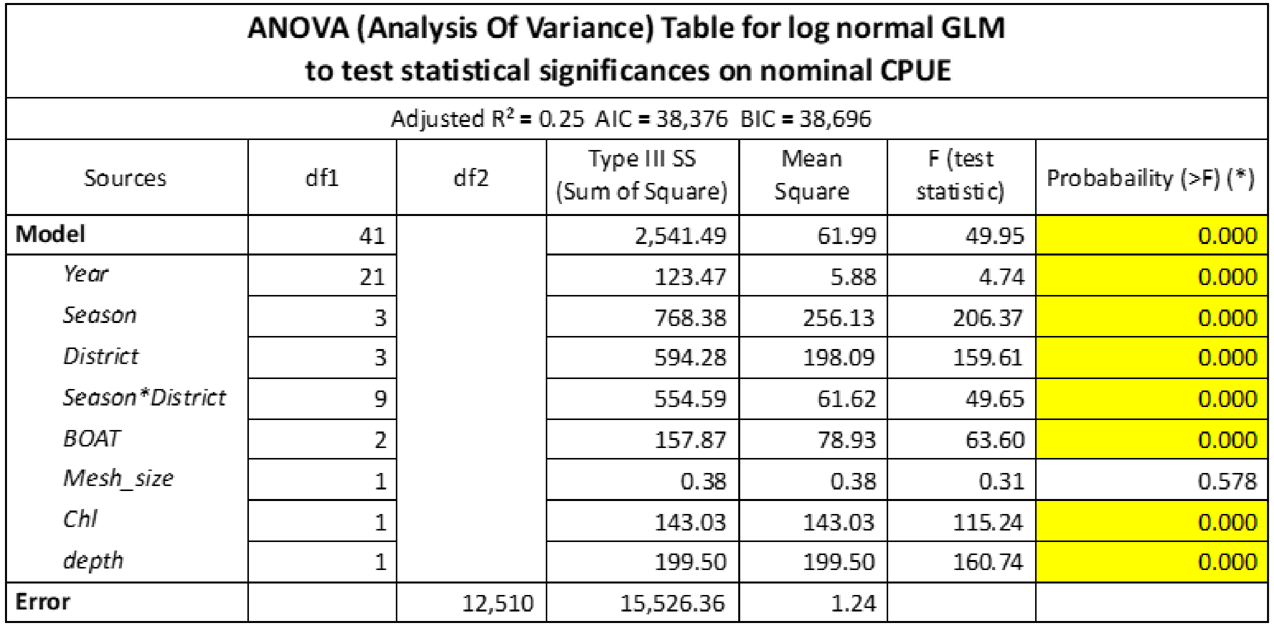
5.4.1 Implementing CPUE standardization (log normal GLM)

② ANOVA Table

Log normal GLM (this case) OK
as Pr < 0.05 for Model

Covariates
if Non significant (NS)
➔ remove or keep

In this example, only Mesh_size is NS.
3 strong covariates bias nominal
CPUE(by order of F values)
➔ Season, depth & District



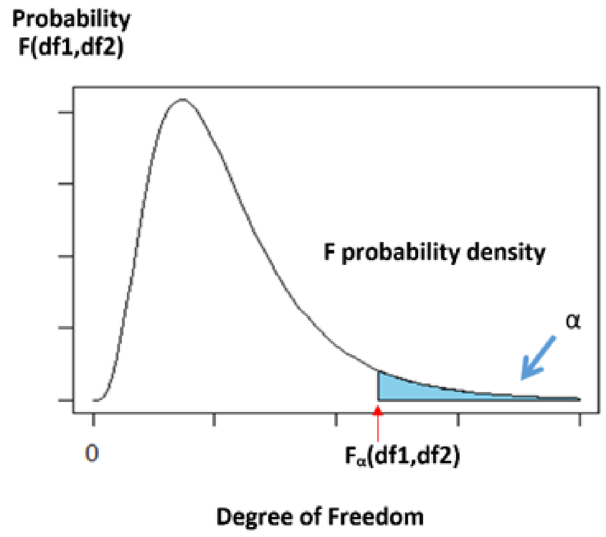
ANOVA (Analysis Of Variance) Table for log normal GLM to test statistical significances on nominal CPUE

Adjusted R^2 = 0.25 AIC = 38,376 BIC = 38,696

Sources	df1	df2	Type III SS (Sum of Square)	Mean Square	F (test statistic)	Probabaility (>F) (*)
Model	41		2,541.49	61.99	49.95	0.000
Year	21		123.47	5.88	4.74	0.000
Season	3		768.38	256.13	206.37	0.000
District	3		594.28	198.09	159.61	0.000
*Season*District*	9		554.59	61.62	49.65	0.000
BOAT	2		157.87	78.93	63.60	0.000
Mesh_size	1		0.38	0.38	0.31	0.578
Chl	1		143.03	143.03	115.24	0.000
depth	1		199.50	199.50	160.74	0.000
Error		12,510	15,526.36	1.24		

[Note]

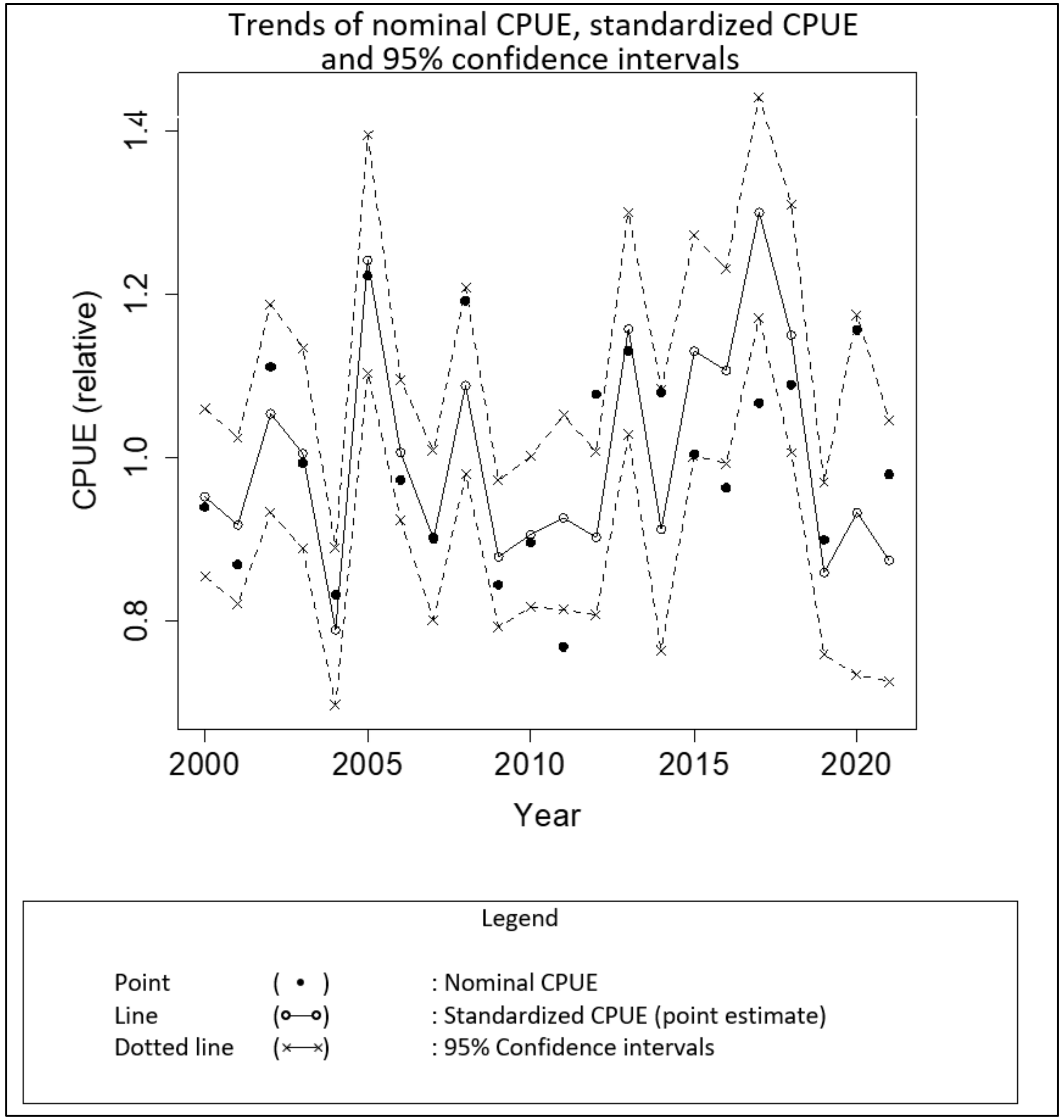
df	Degrees of Freedom
(*)	Yellow marker Indicates $\alpha < 0.05$ (5%)



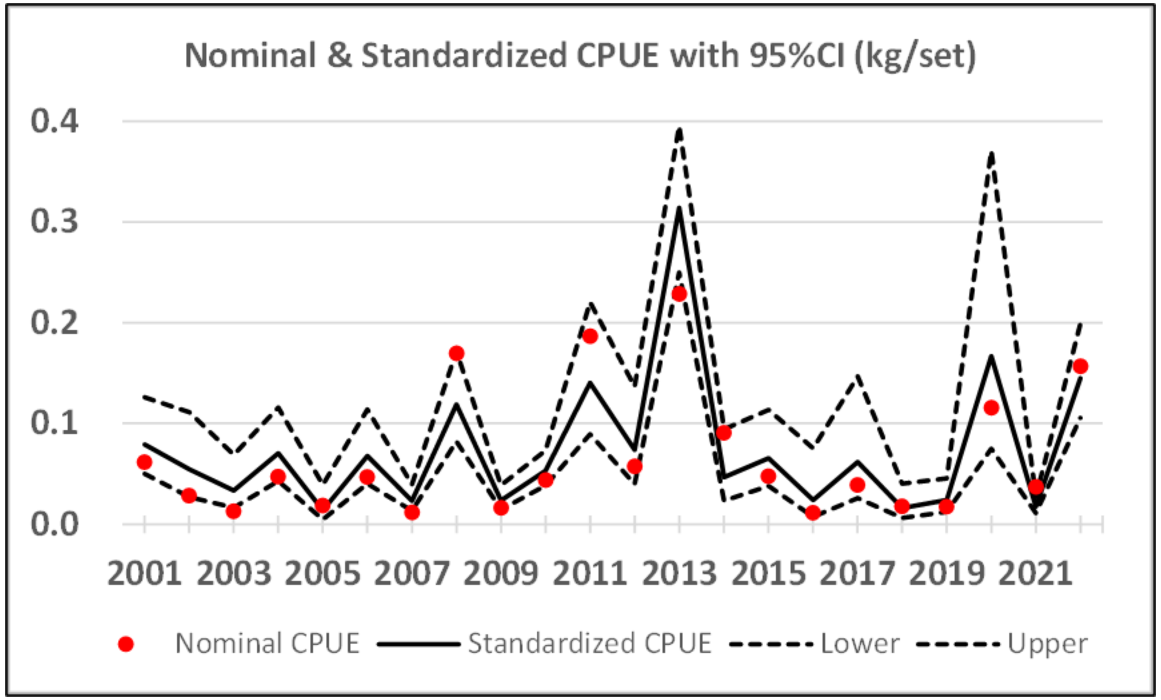
Explanatory note: ANOVA (log normal GLM)

- The ANOVA table shows which covariates (such as year, Q, area, etc.) statistically affect the nominal CPUE and whether the log-normal GLM is statistically significant (acceptable).
- If the covariates have an effect and the model is acceptable, they are indicated by yellow markers.
- If almost all covariates are not significant and/or the model is not acceptable, try other model (for example, zero inflated Delta 2 steps log normal model available in this software).
- If still NG, use nominal CPUE as an approximation.
- Please note that users need to mention such problems in their papers and also remark that results (CPUE standardization and stock assessments) should be treated with caution.
-
- *(Note) “Intercept” term is not available in R used in this software, thus it is not shown in this ANOVA table and ”Intercept” does not relate to acceptance of the model.*

5.4.1 Implementing CPUE standardization(log normal GLM): Output



③ Annual trends of Nominal CPUE
& Standardized CPUE with 95% CI
Left: software output
Right: (users can make) processed graph by excel
(note: example from different data)



5.4.1 Implementing CPUE standardization (log normal GLM): Output

④-1

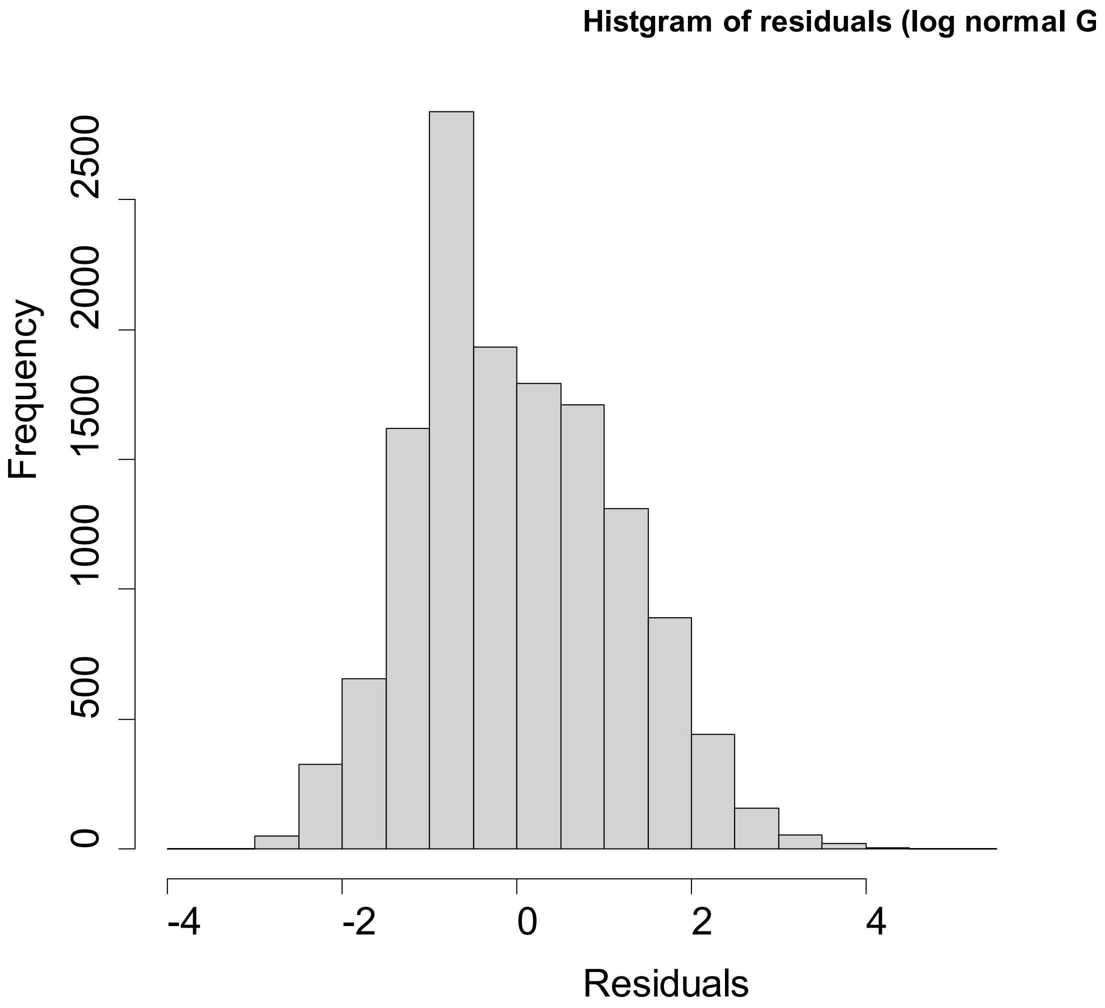
Evaluation of log normal GLM model (Residual analyses)

if Bell shape

↓

model is OK

if not, change model (see next page)



Explanatory note: Histogram of CPUE residuals

- If the frequency distribution of the nominal CPUE residuals (differences between observed and predicted CPUE) forms the bell-shaped normal distributions, the log-normal GLM is statistically acceptable.
- If strange distribution patterns are formed, the log-normal GLM is not acceptable and another model (for example, zero inflated Delta 2 steps log normal GLM available in this software) can be tried.
- If still NG, use nominal CPUE as an approximation.
- Please note that users must mention such problems in their papers and also remark that results (CPUE standardization and stock assessments) should be treated with caution.

5.4.1 Implementing CPUE standardization (log normal GLM): Output

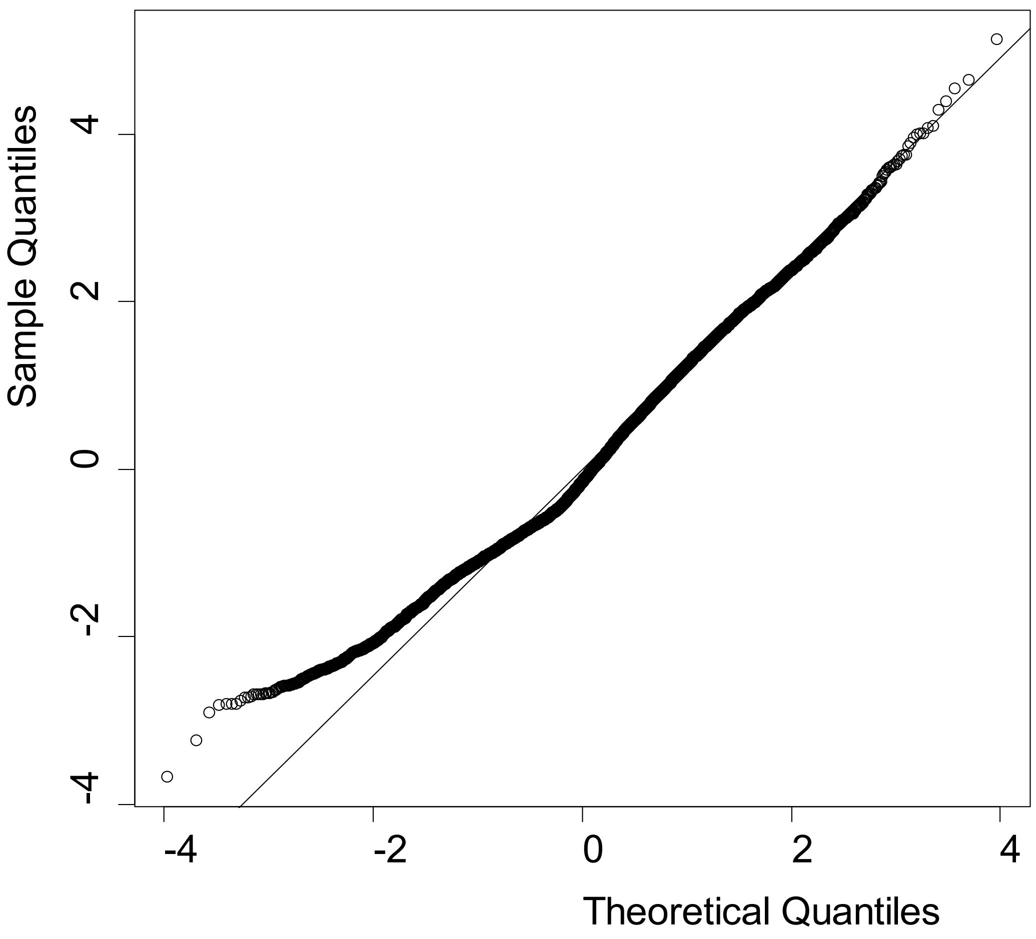
④-2
Evaluation of log normal GLM model
(Residual analysis)
QQ plot

If residuals close
to the straight line

Model is OK

if not, change model
(see next page)

QQplot (log normal GLM)

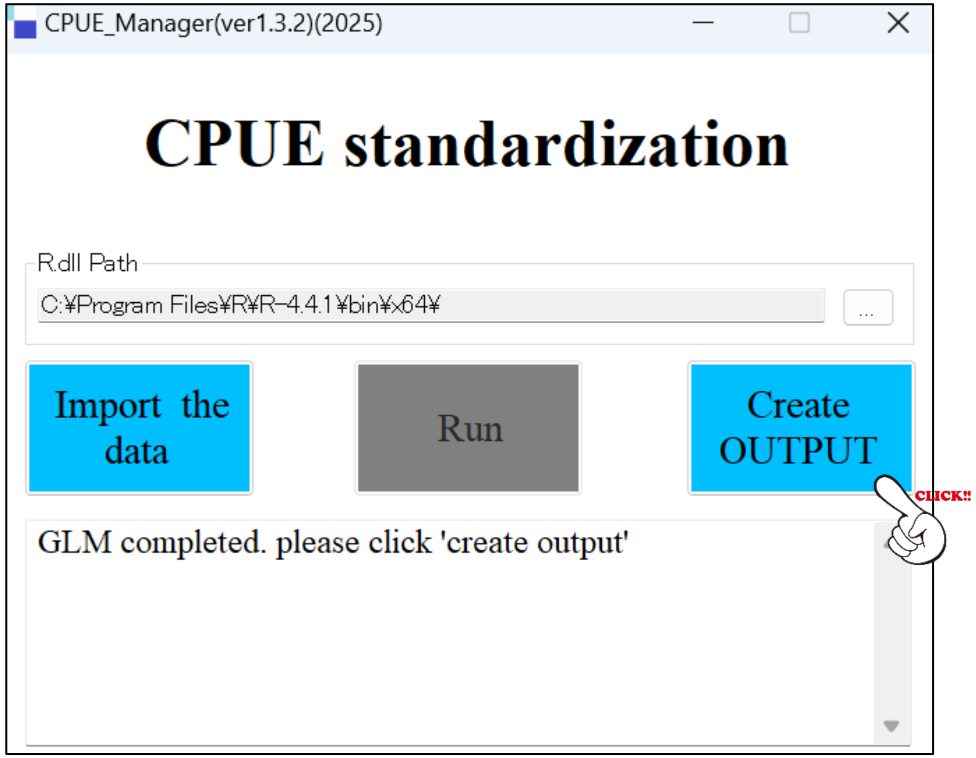


Explanatory note: QQ plot

- A QQ (quantile-quantile) plot is a scatterplot created by plotting two sets of quantiles against each other.
- If both sets of quantiles came from the same distribution, we should see that the points form an approximately straight line.
- Therefore, if the actual QQ plot is close to a straight line, the log normal GLM is acceptable.
- However, if both ends of the scatterplots are far from the line (for example, more than ± 4), and/or strange patterns are formed, the log-normal GLM is not acceptable and another model (for example, zero inflated Delta 2 steps log normal GLM available in this software) can be tried.
- If still NG, use nominal CPUE as an approximation.
- Please note that users must mention such problems in their papers and also indicate that the results (CPUE standardization and stock assessments) should be treated with caution.

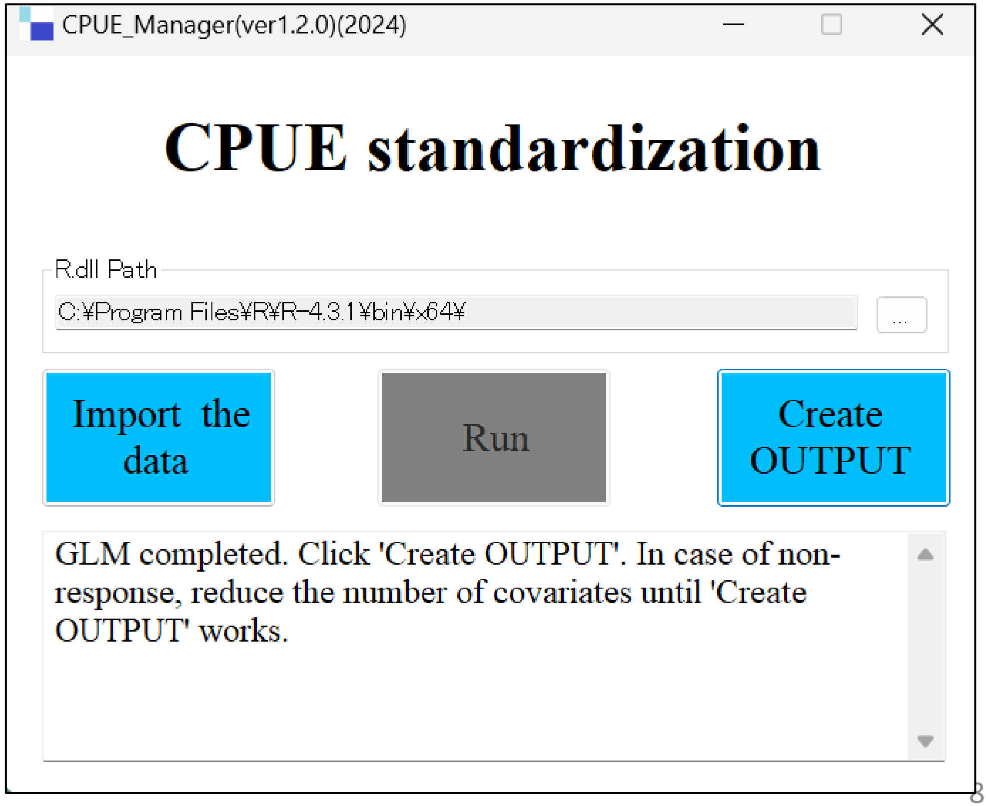
5.4.1 Implementing CPUE standardization(log normal GLM)
In case of non-response after clicking Create OUTPUT

If, after 'Import Data' & 'Run' have been completed successfully, there are no responses from ‘Create OUTPUT' even after clicking, then reduce the number of covariates until ‘Create OUTPUT' works. This will happen if the sample size is too small for some covariates.



C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

GLM completed. please click 'create output'

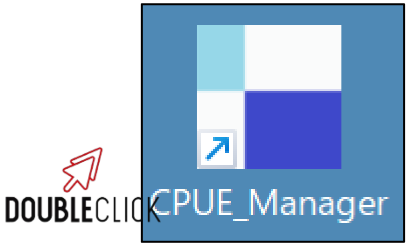


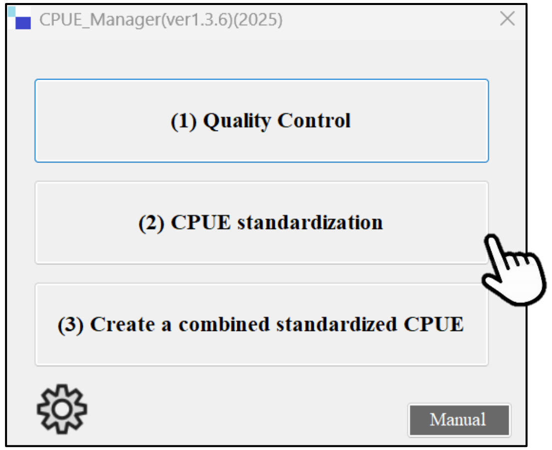
C:¥Program Files¥R¥R-4.3.1¥bin¥x64¥

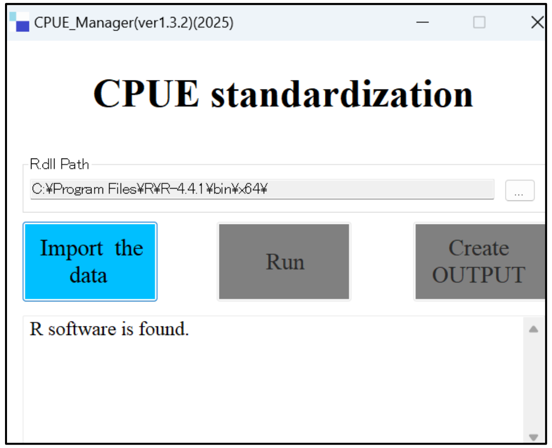
GLM completed. Click 'Create OUTPUT'. In case of non-response, reduce the number of covariates until 'Create OUTPUT' works.

5.4.1 Implementing CPUE standardization (log normal GLM) Summary

5.4.1 Implementing CPUE standardization (log normal GLM) : Summary



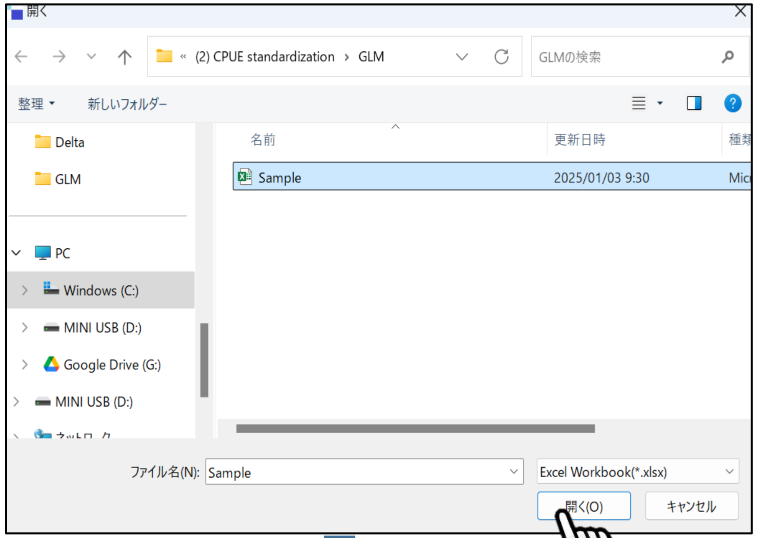

CPUE_Manager(ver1.3.6)(2025)


CPUE_Manager(ver1.3.2)(2025)

CPUE standardization

Rdll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

R software is found.

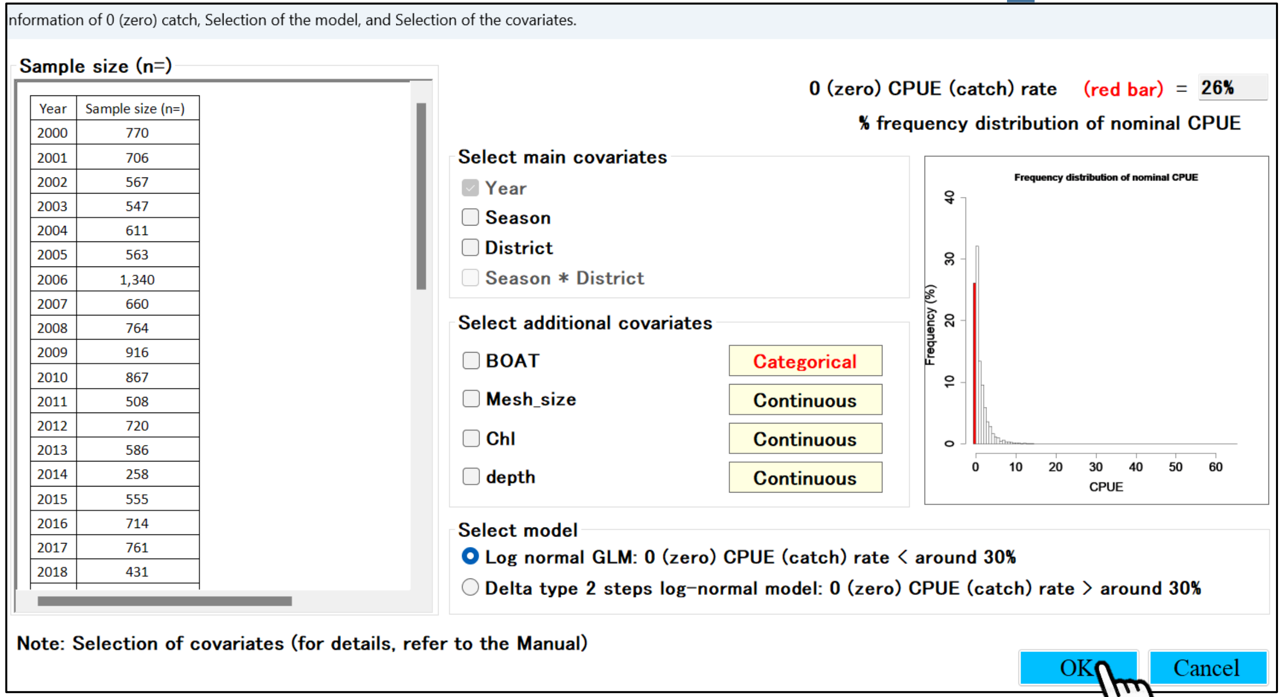

開く

« (2) CPUE standardization › GLM

名前	更新日時
Sample	2025/01/03 9:30

ファイル名(N): Sample

Excel Workbook(*.xlsx)


nformation of 0 (zero) catch, Selection of the model, and Selection of the covariates.

Sample size (n=)

Year	Sample size (n=)
2000	770
2001	706
2002	567
2003	547
2004	611
2005	563
2006	1,340
2007	660
2008	764
2009	916
2010	867
2011	508
2012	720
2013	586
2014	258
2015	555
2016	714
2017	761
2018	431

0 (zero) CPUE (catch) rate (red bar) = 26%

% frequency distribution of nominal CPUE

Select main covariates

- ☑ Year
- ☐ Season
- ☐ District
- ☐ Season * District

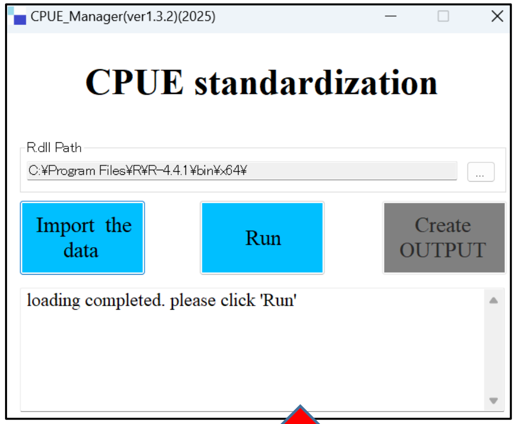
Select additional covariates

- ☐ BOAT — Categorical
- ☐ Mesh_size — Continuous
- ☐ Chl — Continuous
- ☐ depth — Continuous

Select model

- ● Log normal GLM: 0 (zero) CPUE (catch) rate < around 30%
- ○ Delta type 2 steps log-normal model: 0 (zero) CPUE (catch) rate > around 30%

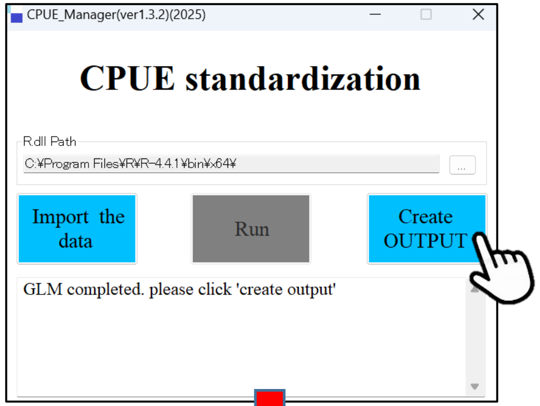
Note: Selection of covariates (for details, refer to the Manual)


CPUE_Manager(ver1.3.2)(2025)

CPUE standardization

Rdll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

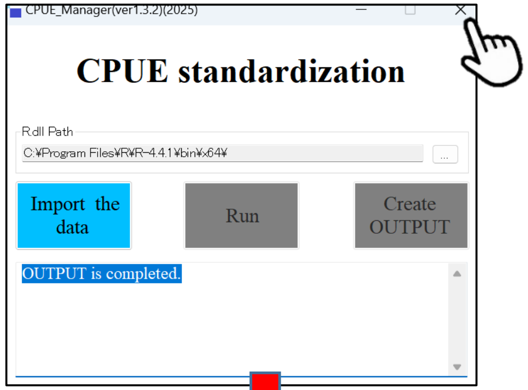
loading completed. please click 'Run'


CPUE_Manager(ver1.3.2)(2025)

CPUE standardization

Rdll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

GLM completed. please click 'create output'


CPUE_Manager(ver1.3.2)(2025)

CPUE standardization

Rdll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

OUTPUT is completed.

3 output files are created in users' working folder.

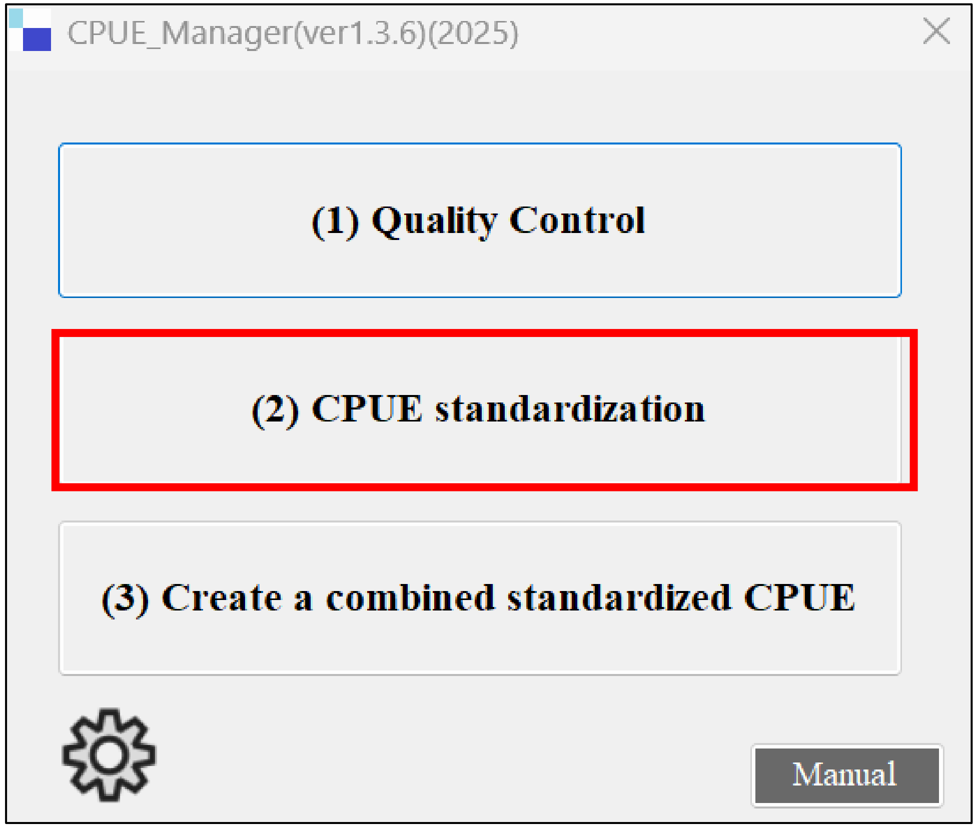
5.4.2 Implementing CPUE standardization (**Delta model**)

Zero inflated Delta 2 steps log normal GLM: Outline

What is the Delta model
(Zero inflated Delta 2 steps log normal GLM)

The delta-lognormal model is a two-step process in which the probability of CPUE being non-zero (i.e. the probability of being caught) is estimated using a logit model, and then the lognormal model is applied to the non-zero portion only to estimate CPUE, and the two results are multiplied together to estimate the standardized CPUE.

5.4.2 Implementing CPUE standardization Delta model



REMARKS: How to apply [C] Delta model

(1) If 0 CPUE rate > 60%, then [C] needs to be used, while [B] for 30~60%.

(2) As [B] is not available, [C] (alternate method) will be applied as the 1st trial.

(4) If results NG, [A] will be used as the 2nd trial.

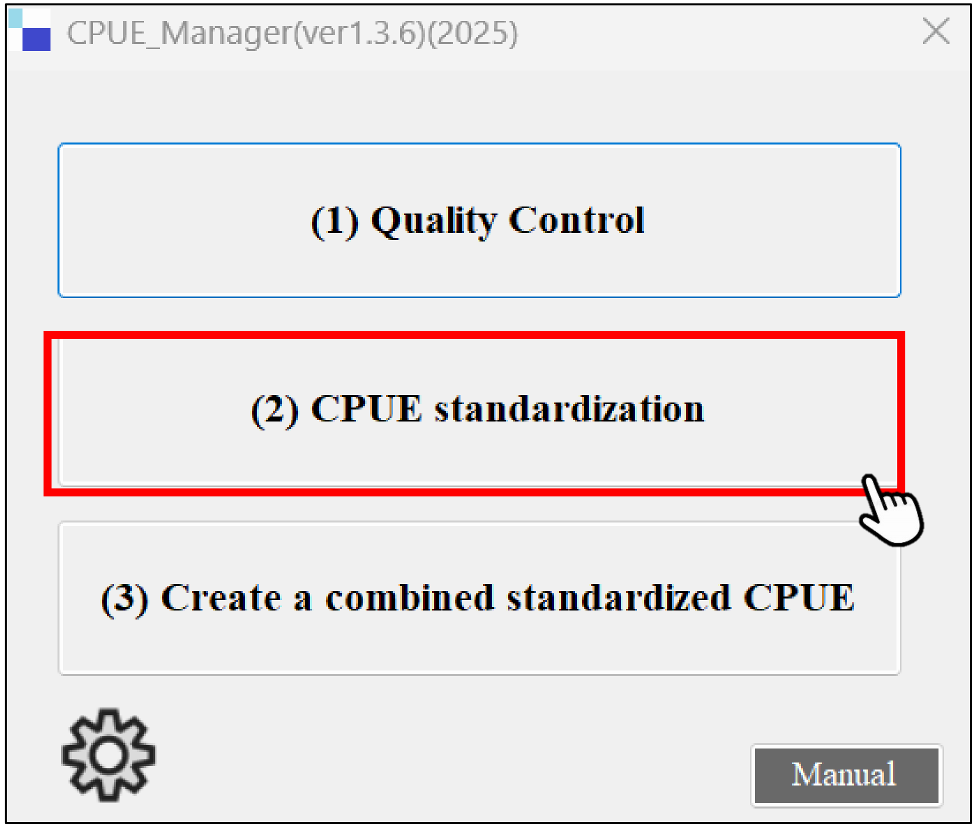
(5) If still NG, then use the nominal CPUE.

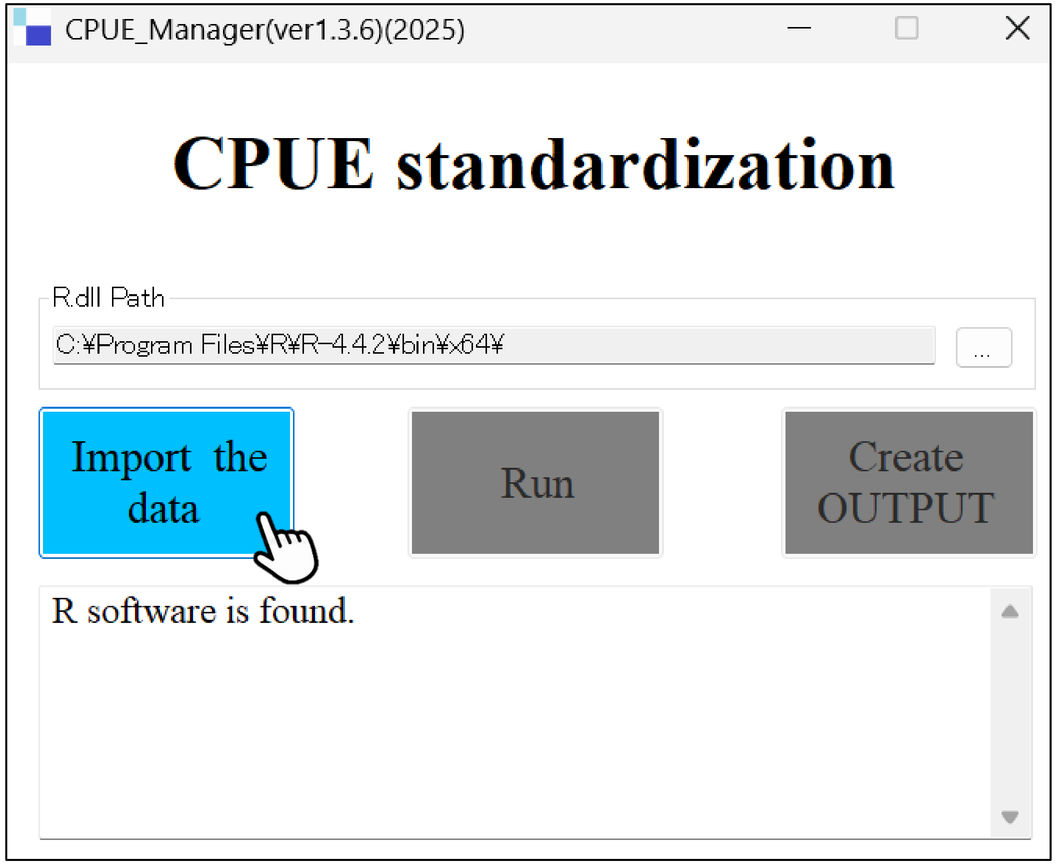
0 catch (CPUE) rate (%)	Model	Short name	Availability (this software)	Alternative (approximate) approach for [B]
~30%	[A] Log normal GLM	Log normal model	YES	
30%~60%	[B] Catch-Negative Binominal model	Catch model	NO	Try [C] first & if results are NG, try [A]. If still NG, use nominal CPUE.
60%~	[C]Zero inflated Delta 2 steps log normal GLM (*)	Delta model	YES	

(*) Tweedie model or Zero inflated Poisson/Negative binominal model can be also applied.

5.4.2 Implementing CPUE standardization (Delta model)

Importing the nominal CPUE data set



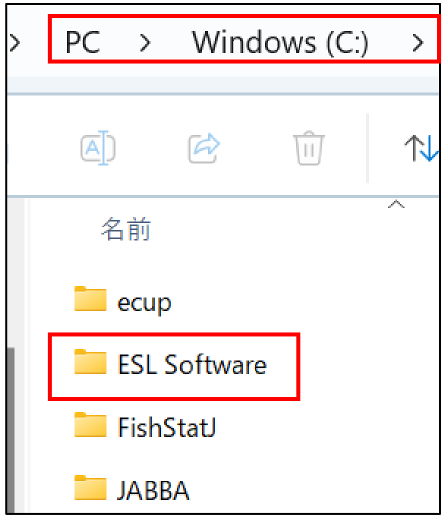


R.dll Path: C:¥Program Files¥R¥R-4.4.2¥bin¥x64¥

R software is found.

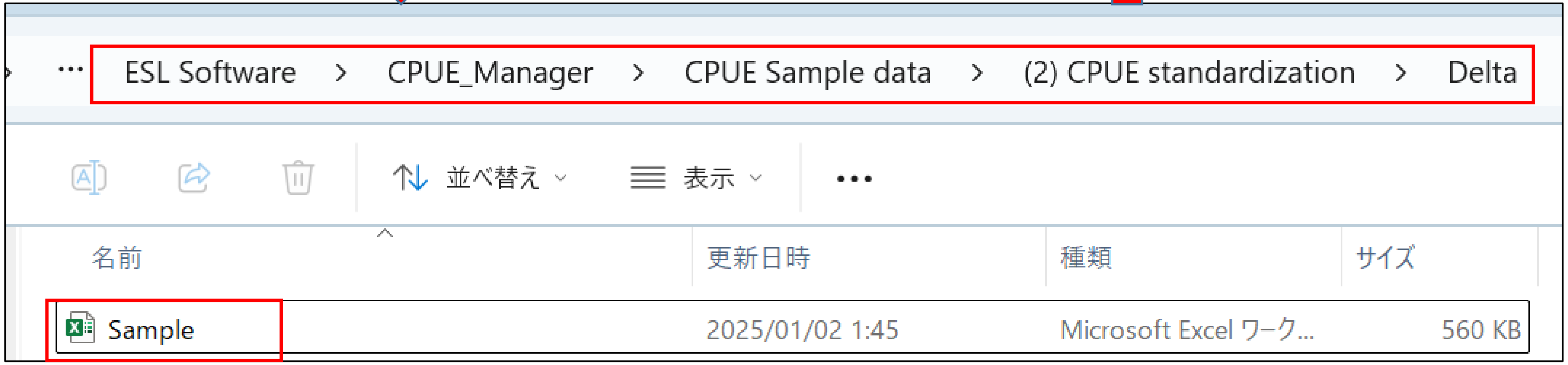
5.4.2 Implementing CPUE standardization (Delta model)
Importing the nominal CPUE data set ➔ Sample

Sample data is available
in ESL software folder in C:



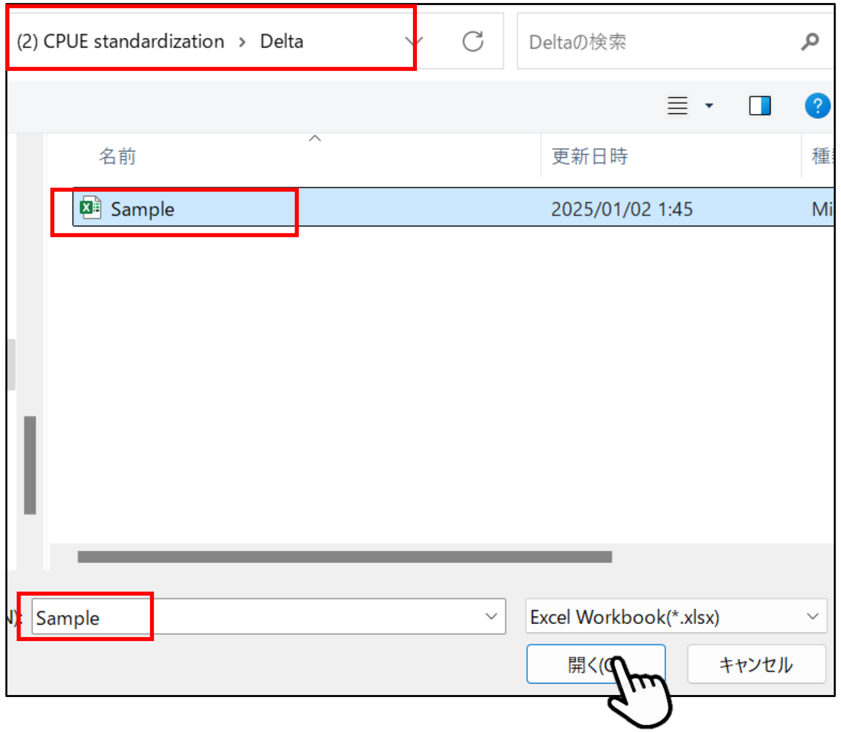
PC > Windows (C:) >

ecup
ESL Software
FishStatJ
JABBA



… ESL Software > CPUE_Manager > CPUE Sample data > (2) CPUE standardization > Delta

名前	更新日時	種類	サイズ
Sample	2025/01/02 1:45	Microsoft Excel ワーク...	560 KB

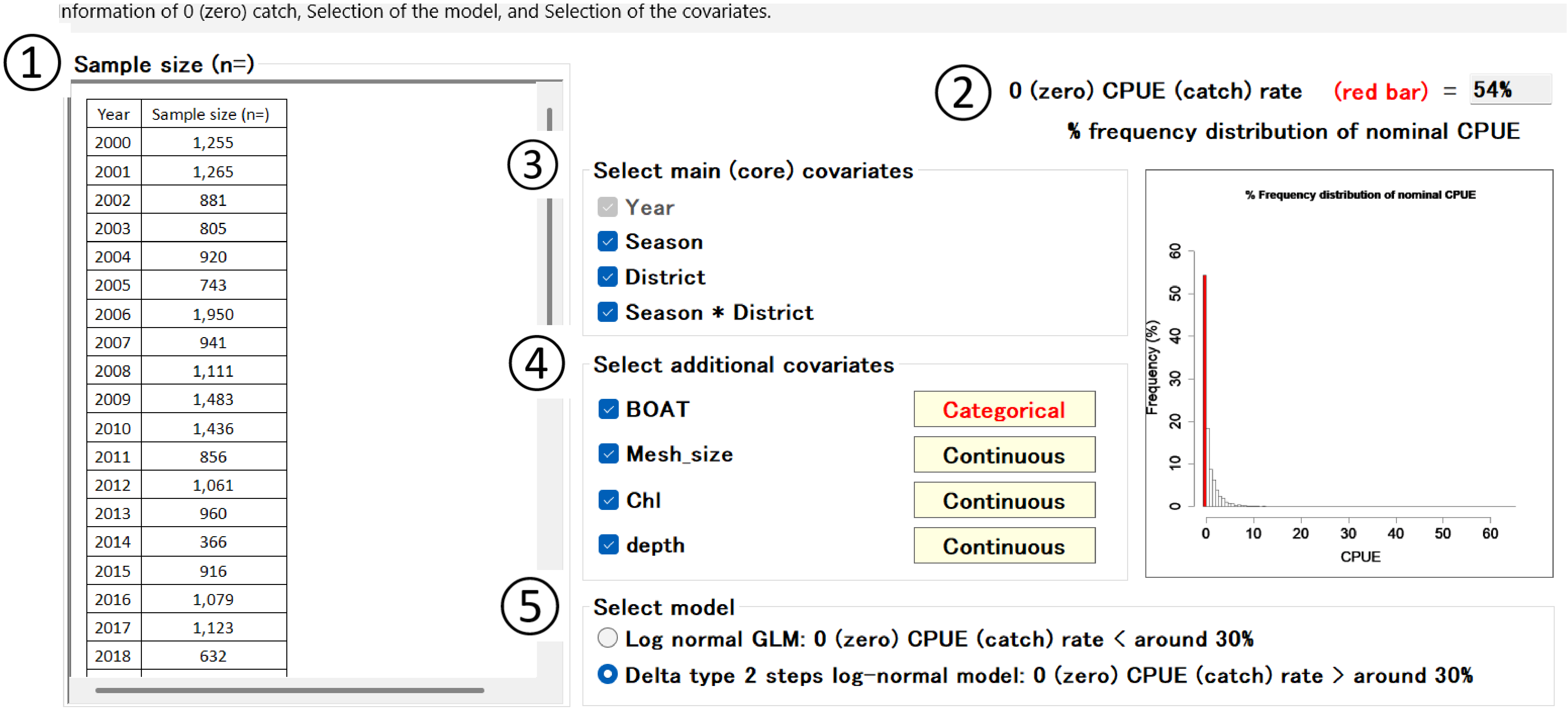


(2) CPUE standardization > Delta

名前	更新日時	種
Sample	2025/01/02 1:45	Mi

Sample
Excel Workbook(*.xlsx)

5.4.2 Implementing CPUE standardization (Delta): 1st window



nformation of 0 (zero) catch, Selection of the model, and Selection of the covariates.

① **Sample size (n=)**

Year	Sample size (n=)
2000	1,255
2001	1,265
2002	881
2003	805
2004	920
2005	743
2006	1,950
2007	941
2008	1,111
2009	1,483
2010	1,436
2011	856
2012	1,061
2013	960
2014	366
2015	916
2016	1,079
2017	1,123
2018	632

② 0 (zero) CPUE (catch) rate (red bar) = 54%

% frequency distribution of nominal CPUE

③ **Select main (core) covariates**

- ☑ Year
- ☑ Season
- ☑ District
- ☑ Season * District

④ **Select additional covariates**

- ☑ BOAT — Categorical
- ☑ Mesh_size — Continuous
- ☑ Chl — Continuous
- ☑ depth — Continuous

⑤ **Select model**

- ○ Log normal GLM: 0 (zero) CPUE (catch) rate < around 30%
- ● Delta type 2 steps log-normal model: 0 (zero) CPUE (catch) rate > around 30%

(Note) If result of the Delta model is NG 0 CPUE rate is 30%~60%, try log normal GLM Including 0 CPUE.

If still NG, use nominal CPUE.

OK Cancel

5.4.2 Implementing CPUE standardization (Delta model)

① **Sample size (n=)**

If sample size (covariates & nominal CPUE) is not enough (n < 10),
follow suggestions as below:

If number of years < 10

➔ Better not conduct “CPUE standardization” nor “ stock assessment”

as not enough # of years ➔ produce unreliable results

If year(n)≥ 10 and n < 10 (Season, area & one categorical data)

➔ Delete or Change to larger category as examples below:

If # of data in some month < 10 ➔ Change to Quarter

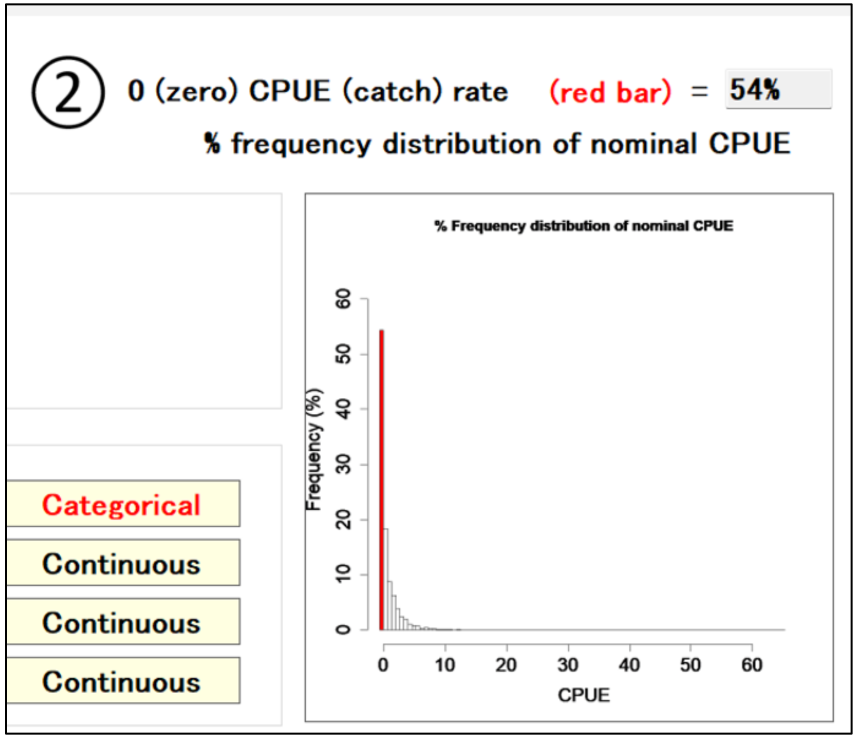
If # of data in some areas (5 areas) <10 ➔ change to 3 areas

If some class (5 boat class)< 10 ➔ change to 3 classes

so that enough sample sizes can be secured.

# of data (3 continuous covariates) < 10, delete & do not use.

5.4.2 Implementing CPUE standardization (Delta model)
② 0 (zero) catch (CPUE) rate



② 0 (zero) CPUE (catch) rate (red bar) = 54%

% frequency distribution of nominal CPUE

Categorical

Continuous

Continuous

Continuous

Red bar (% frequency distribution)

(in the nominal CPUE data set)

↓

0 catch (CPUE) rate

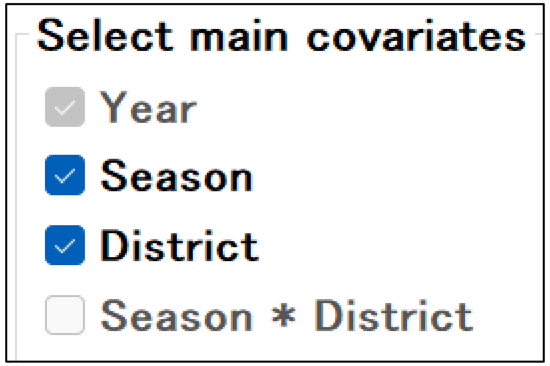
↓

To be utilized in ⑤ (model selection).

In this case, 0 catch rate=54%

5.4.2 Implementing CPUE standardization (Delta model)

③ Selection of main (core) covariates (1/2)



Select main covariates

☑ Year

☑ Season

☑ District

☐ Season * District

3 main (core) covariates

➔Year, Season (month, quarter, etc.) & area (District, fishing grounds, etc.)

Users can select interaction (Season*District) if no missing data.

In the example (left), it is masked due to missing values in either Season or District.

Please see next pager, the reason why other interaction are not needed.

Please enter check marks ☑ if you have Covariates.

Y(year) is the essential covariate to estimate annual CPUE standardization

If users have missing years, ignore them and enter only available years.

Then standardized CPUE will be made by skipping missing years.

5.4.2 Implementing CPUE standardization (Delta model)

③ **Selection of covariates (2/2)**

Y(year) related interaction (e.g., year*month & year*area) ➔ NO need
Because interpretations are difficult due to complex situation

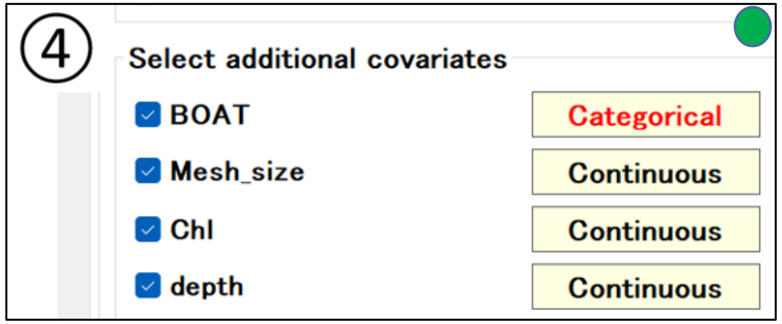
Hinton & Maunder (2004) ➔ invalid

↓

Maunder & Punt (2004)
Identifying significant interactions with year
➔ no need (impossible to explain)

5.4.2 Implementing CPUE standardization: Delta model

④ **Selection : Additional 4 covariates (option)**



④

Select additional covariates

☑ BOAT Categorical

☑ Mesh_size Continuous

☑ Chl Continuous

☑ depth Continuous

There are 4 additional (optional) Covariates

- 1 for categorical data

Examples Boat class (small, medium, large)

Skipper's skill (normal, good, excellent)

- 3 for continuous data

Examples Environmental data (temperature, salinity, depth, etc.)

Mesh size, etc.

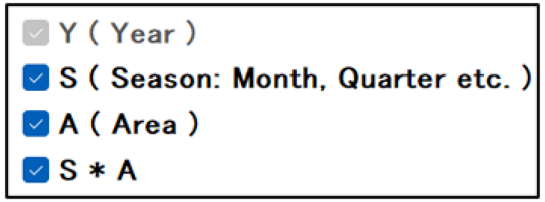
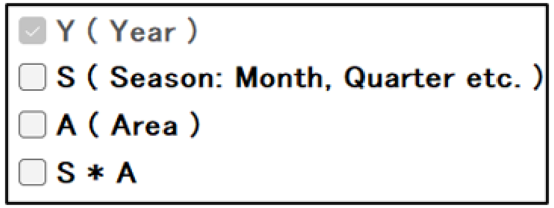
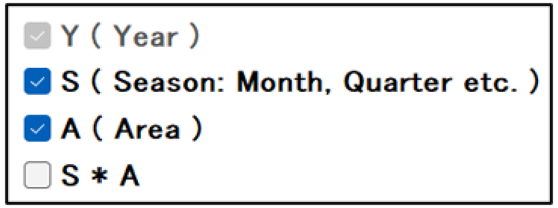
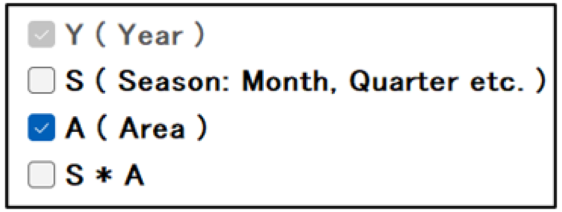
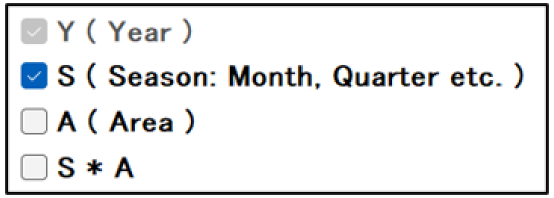
→ If users have such data, enter check mark ☑

5.4.2 Implementing CPUE standardization (Delta model)
④ **Selection of covariates (2/3)**

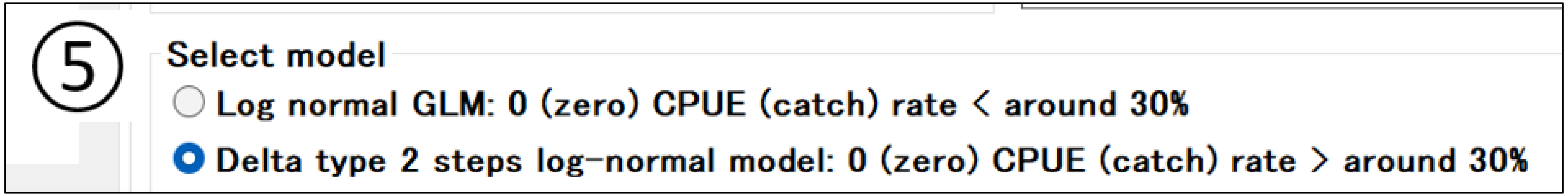
Selection of covariates according to the situation of missing values using season & area (example)

Y(year) ➔ Always selected (masked) (to estimate annual standardized CPUE)

If users have other covariate names (e.g., mesh size, boat size), the same are applied.

Missing values		Selection of Covariates
Season	Area	
no	no	 ☑ Y (Year) ☑ S (Season: Month, Quarter etc.) ☑ A (Area) ☑ S ＊ A
all	all	 ☑ Y (Year) ☐ S (Season: Month, Quarter etc.) ☐ A (Area) ☐ S ＊ A
some	some	 ☑ Y (Year) ☑ S (Season: Month, Quarter etc.) ☑ A (Area) ☐ S ＊ A
all	some	 ☑ Y (Year) ☐ S (Season: Month, Quarter etc.) ☑ A (Area) ☐ S ＊ A
some	all	 ☑ Y (Year) ☑ S (Season: Month, Quarter etc.) ☐ A (Area) ☐ S ＊ A

5.4.2 Implementing CPUE standardization (Delta model)
⑤ Selection of model by 0 catch rate



⑤

Select model

○ Log normal GLM: 0 (zero) CPUE (catch) rate < around 30%

● Delta type 2 steps log-normal model: 0 (zero) CPUE (catch) rate > around 30%

This software uses 2 models for CPUE standardization
depending upon 0 catch (CPUE) rate(below).

0 catch rate (%)	Model	Short name	Details (Manual)
0% ～ 30%	Log normal GLM	Log normal model	Section 5.4.1
30% ～	Zero (0) inflated Delta 2 steps log normal GLM	Delta model	Section 5.4.2

The software will automatically let users inform 0 catch rates
and corresponding model after users start the menu (2).

REMARKS: How to apply [C] Delta model

(1) If 0 CPUE rate > 60%, then [C] needs to be used, while [B] for 30~60%.

(2) As [B] is not available, [C] (alternate method) will be applied as the 1st trial.

(4) If results NG, [A] will be used as the 2nd trial.

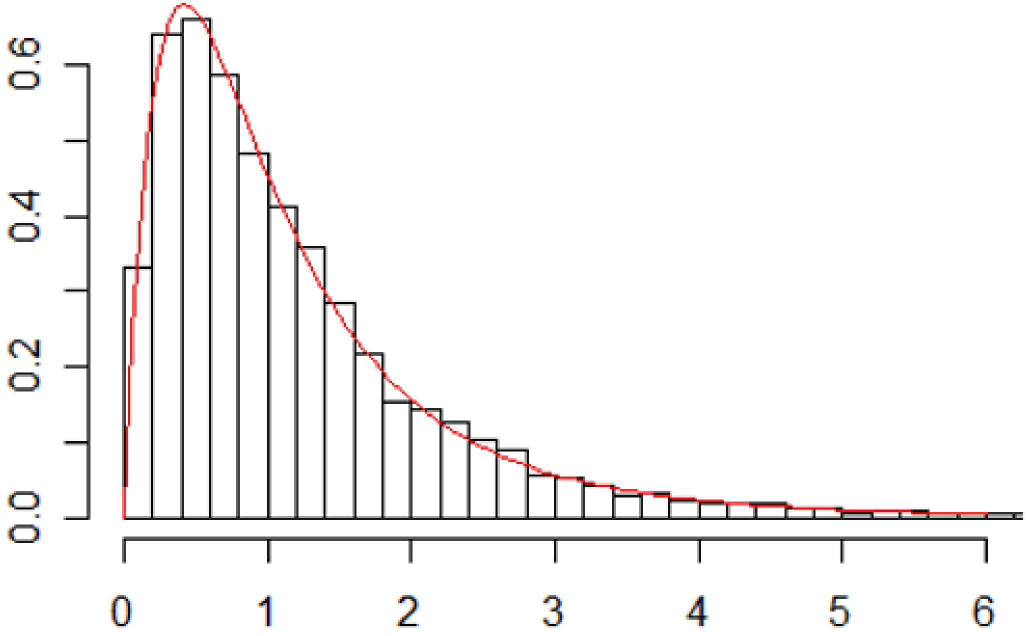
(5) If still NG, then use the nominal CPUE.

0 catch (CPUE) rate (%)	Model	Short name	Availability (this software)	Alternative (approximate) approach for [B]
~30%	[A] Log normal GLM	Log normal model	YES	
30%~60%	[B] Catch-Negative Binominal model	Catch model	NO	Try [C] first & if results are NG, try [A]. If still NG, use nominal CPUE.
60%~	[C]Zero inflated Delta 2 steps log normal GLM (*)	Delta model	YES	

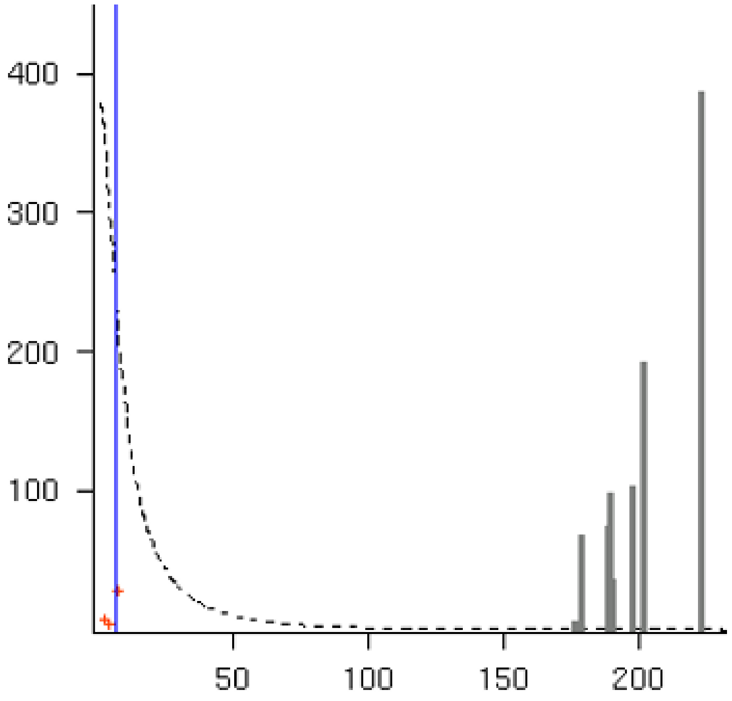
(*) Tweedie model or Zero inflated Poisson/Negative binominal model can be also applied.

5.4.2 Implementing CPUE standardization **(Delta model)**
⑤ **Selection of Delta model by 0 catch rate**

Frequency distributions (0 catch) like below)➔ do not use.
but rarely happened



Long (fat) tail



Non-monotonic decreasing
trend with pulse at the end

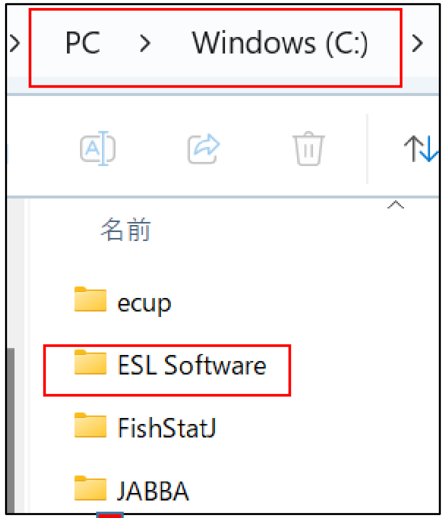
5.4.2 Implementing CPUE standardization (Delta model)

5.4.2 Implementing CPUE standardization (Delta model)

Output

5.4.2 Implementing CPUE standardization (log normal GLM)

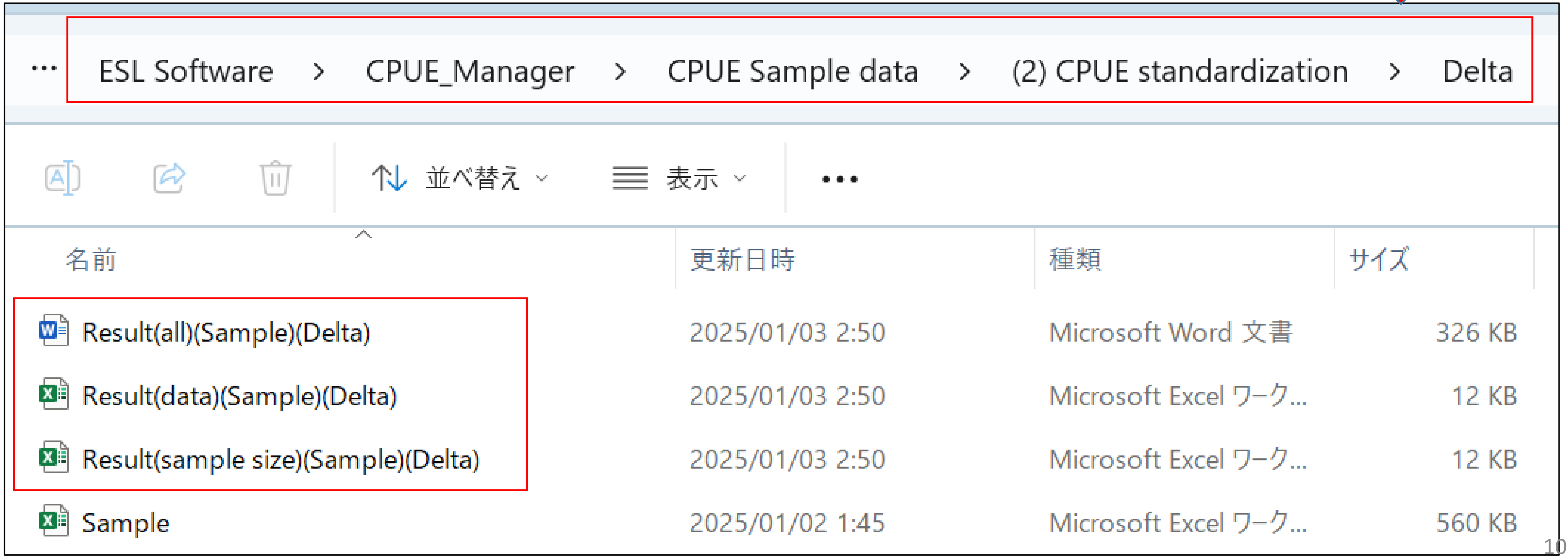
Results folders & files for sample data are available in ESL software folder



PC > Windows (C:) >

名前

- ecup
- ESL Software
- FishStatJ
- JABBA



… ESL Software > CPUE_Manager > CPUE Sample data > (2) CPUE standardization > Delta

名前	更新日時	種類	サイズ
Result(all)(Sample)(Delta)	2025/01/03 2:50	Microsoft Word 文書	326 KB
Result(data)(Sample)(Delta)	2025/01/03 2:50	Microsoft Excel ワーク...	12 KB
Result(sample size)(Sample)(Delta)	2025/01/03 2:50	Microsoft Excel ワーク...	12 KB
Sample	2025/01/02 1:45	Microsoft Excel ワーク...	560 KB

5.4.2 Implementing CPUE standardization **(Delta model）: 3 outputs**

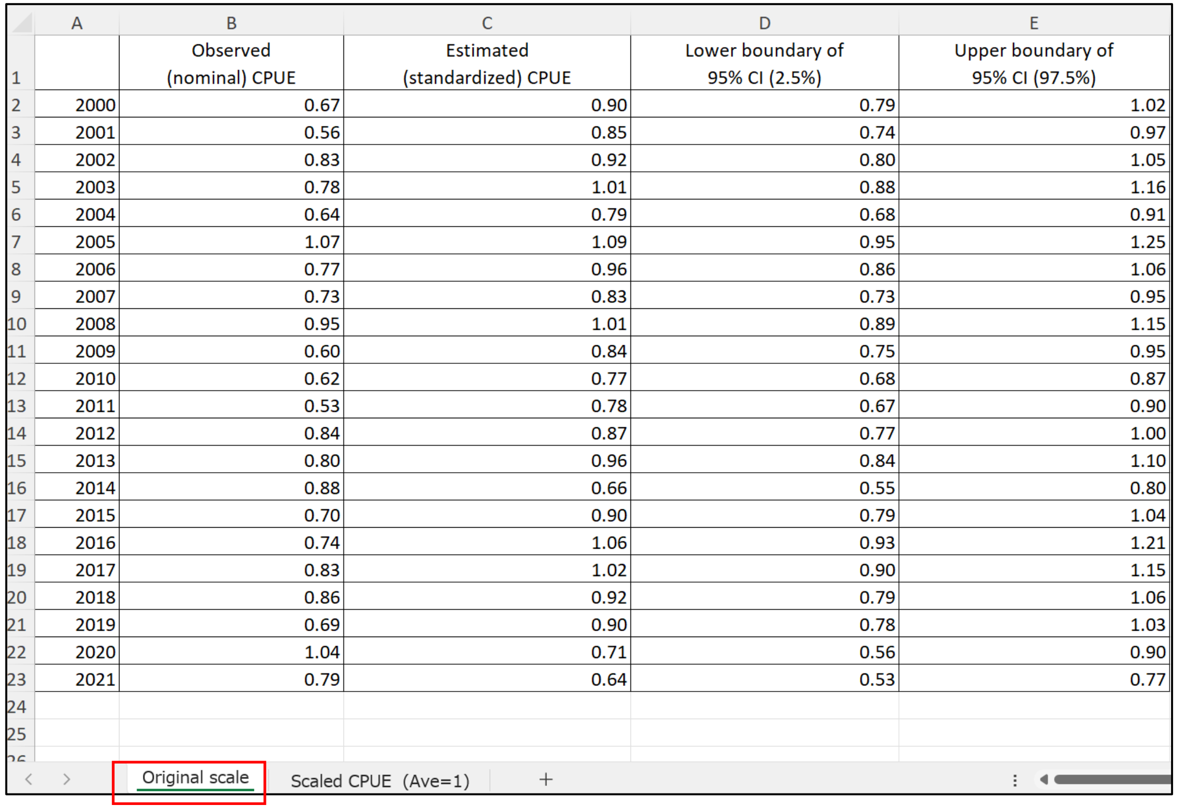
Output file #	Results	Contents	Type	File name
(1)	① Sample size of covariates	Year, season, area, and interaction (season*area)	Data	Result(sample size)(Sample)(Delta)
(2)	① Standardized CPUE (Real values)	Standardized CPUE and 95% CI with nominal CPUE		Result(data)(Sample)(Delta)
	② Standardized CPUE (Scaled as average =1)			
(3)	① 0 (zero) catch rate	% freq. distribution of nominal CPUE with 0 catch rate	Graph	Result(all)(Sample)(Delta)
	② Two ANOVA Tables (Analyses Of Variances)	Statistical tests for a) delta (0 CPUE) model. b) log normal GLM & covariates (non 0 CPUE data)	Tables	
	③ Standardized CPUE Real values and Scaled (As average=1)	Standardized CPUE and 95% CI with nominal CPUE	Graphs	
	④ Residual analyses (Histograms and QQ plot)	To evaluate delta model and log normal GLM (non-zero CPUE data)		

5.4.2 Implementing CPU standardization (Delta model): Output

Result(data)(Sample)(Delta)

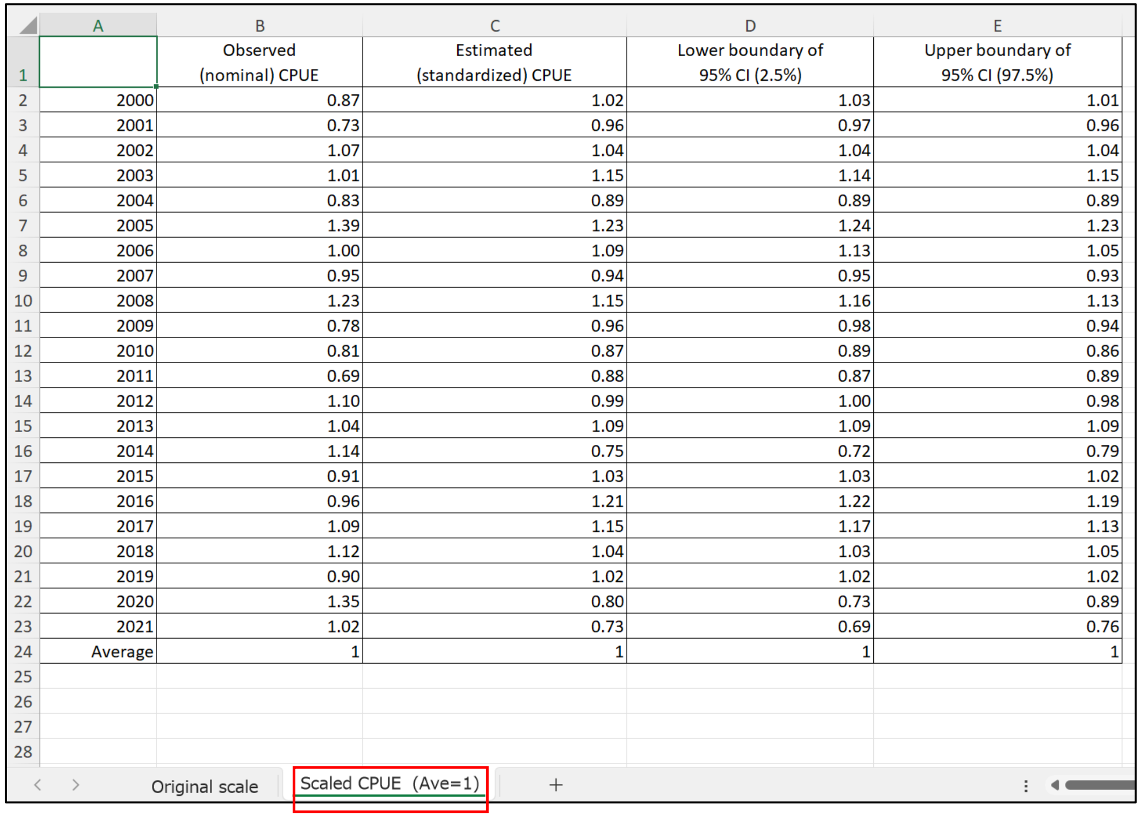
(2) Standardized CPUE (for non-0 CPUE) with its 95% CI (Confidence Intervals) & nominal CPUE (results in 2 excel sheets)

Original scale



	Observed (nominal) CPUE	Estimated (standardized) CPUE	Lower boundary of 95% CI (2.5%)	Upper boundary of 95% CI (97.5%)
2000	0.67	0.90	0.79	1.02
2001	0.56	0.85	0.74	0.97
2002	0.83	0.92	0.80	1.05
2003	0.78	1.01	0.88	1.16
2004	0.64	0.79	0.68	0.91
2005	1.07	1.09	0.95	1.25
2006	0.77	0.96	0.86	1.06
2007	0.73	0.83	0.73	0.95
2008	0.95	1.01	0.89	1.15
2009	0.60	0.84	0.75	0.95
2010	0.62	0.77	0.68	0.87
2011	0.53	0.78	0.67	0.90
2012	0.84	0.87	0.77	1.00
2013	0.80	0.96	0.84	1.10
2014	0.88	0.66	0.55	0.80
2015	0.70	0.90	0.79	1.04
2016	0.74	1.06	0.93	1.21
2017	0.83	1.02	0.90	1.15
2018	0.86	0.92	0.79	1.06
2019	0.69	0.90	0.78	1.03
2020	1.04	0.71	0.56	0.90
2021	0.79	0.64	0.53	0.77

Scaled as Ave=1



	Observed (nominal) CPUE	Estimated (standardized) CPUE	Lower boundary of 95% CI (2.5%)	Upper boundary of 95% CI (97.5%)
2000	0.87	1.02	1.03	1.01
2001	0.73	0.96	0.97	0.96
2002	1.07	1.04	1.04	1.04
2003	1.01	1.15	1.14	1.15
2004	0.83	0.89	0.89	0.89
2005	1.39	1.23	1.24	1.23
2006	1.00	1.09	1.13	1.05
2007	0.95	0.94	0.95	0.93
2008	1.23	1.15	1.16	1.13
2009	0.78	0.96	0.98	0.94
2010	0.81	0.87	0.89	0.86
2011	0.69	0.88	0.87	0.89
2012	1.10	0.99	1.00	0.98
2013	1.04	1.09	1.09	1.09
2014	1.14	0.75	0.72	0.79
2015	0.91	1.03	1.03	1.02
2016	0.96	1.21	1.22	1.19
2017	1.09	1.15	1.17	1.13
2018	1.12	1.04	1.03	1.05
2019	0.90	1.02	1.02	1.02
2020	1.35	0.80	0.73	0.89
2021	1.02	0.73	0.69	0.76
Average	1	1	1	1

5.4.2 Implementing CPUE standardization（Delta model）: Output

(3) Report (word) file

Result(all)(Sample)(Delta)

① % frequency distribution of 0 (zero) catch (CPUE) and % of 0 catch (CPUE)

② 2 ANOVA (Analysis Of Variance) Tables (0 CPUE delta & non-0 CPUE log normal GLM)

③ Trends of 4 annual CPUE (nominal, standardized and its 95% CI)

④ Evaluate model suitability (3 residual analyses)

-2 histogram analyses for log normal GLM & Delta model

-QQ plot for log normal GLM

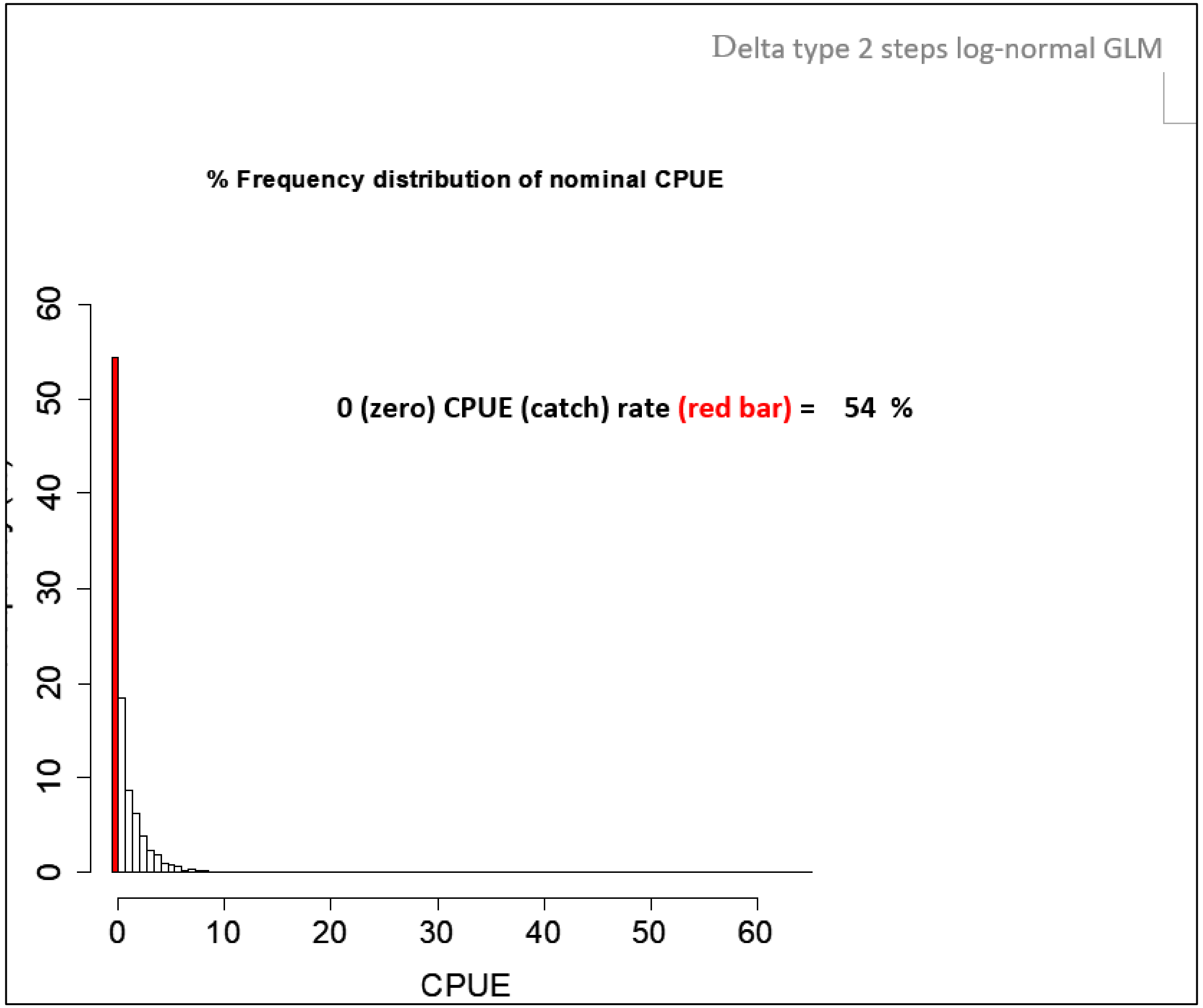
5.4.2 Implementing CPUE standardization（Delta model）
Output(3) Report (word) file

①
% frequency
distribution of
nominal CPUE

Red bar

0 CPUE (catch) rate

if > 30%
use the delta mode

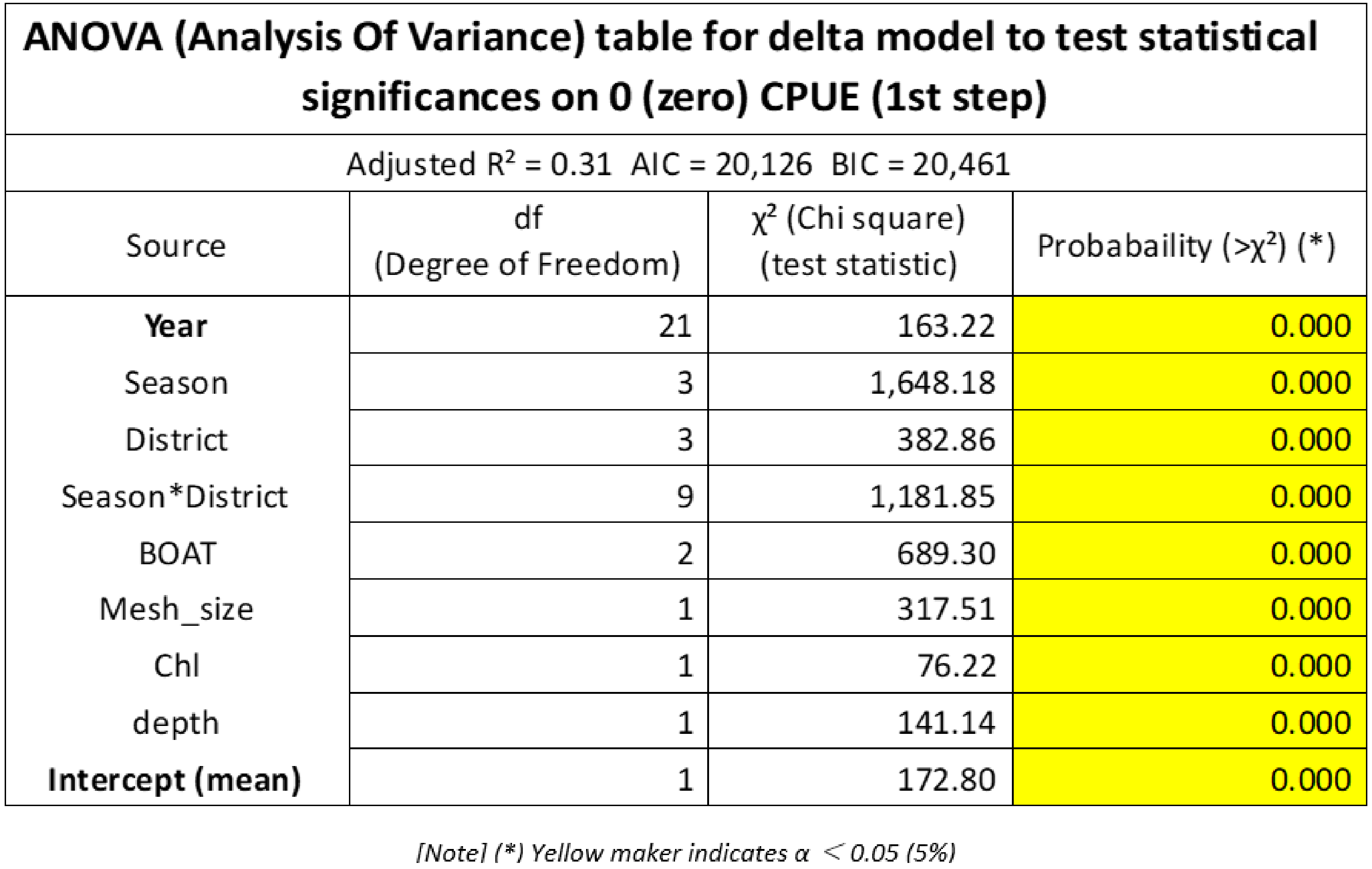


5.4.2 Implementing CPUE standardization（Delta model）
Output(3) Report (word) file

② 1st ANOVA Table
if Pr < 0.05
for major covariates
(significant➔ affect 0 CPUE)

Delta model OK

Otherwise
(Covariates not affect 0 CPUE)
➔skip the 2nd step
and use log normal
GLM for original data
including 0 catch
(see next)



ANOVA (Analysis Of Variance) table for delta model to test statistical significances on 0 (zero) CPUE (1st step)

Adjusted R^2 = 0.31 AIC = 20,126 BIC = 20,461

Source	df (Degree of Freedom)	χ^2 (Chi square) (test statistic)	Probabaility (>χ^2) (*)
Year	21	163.22	0.000
Season	3	1,648.18	0.000
District	3	382.86	0.000
Season*District	9	1,181.85	0.000
BOAT	2	689.30	0.000
Mesh_size	1	317.51	0.000
Chl	1	76.22	0.000
depth	1	141.14	0.000
Intercept (mean)	1	172.80	0.000

[Note] (*) Yellow maker indicates $\alpha < 0.05$ *(5%)*

All Covariates & mean significantly affect 0-CPUE 横井
3 strong Covariate (by F values)➔ Season, Season*district & depth

Explanatory note: ANOVA (Delta model for 0 CPUE)

- The ANOVA table shows which covariates (such as year, Q, area, etc.) statistically affect the nominal 0 CPUE and whether the delta model is statistically significant (acceptable).
- If the covariates have an effect, they are indicated by yellow markers. If almost all covariates are not significant, try another model (for example, log-normal GLM including 0 CPUE available in this software).
- If still NG, use nominal CPUE as an approximation.
- Please note that users need to mention such problems in their papers and also mention that results (CPUE standardization and stock assessments) should be treated with caution.

(Note) “Model” and “random errors (residuals)” are not available in R used this software, thus they are not shown in this ANOVA table and ”Intercept” does not relate to acceptance of the model.

5.4.2 Implementing CPUE standardization (Delta model）
Output(3) Report (word) file

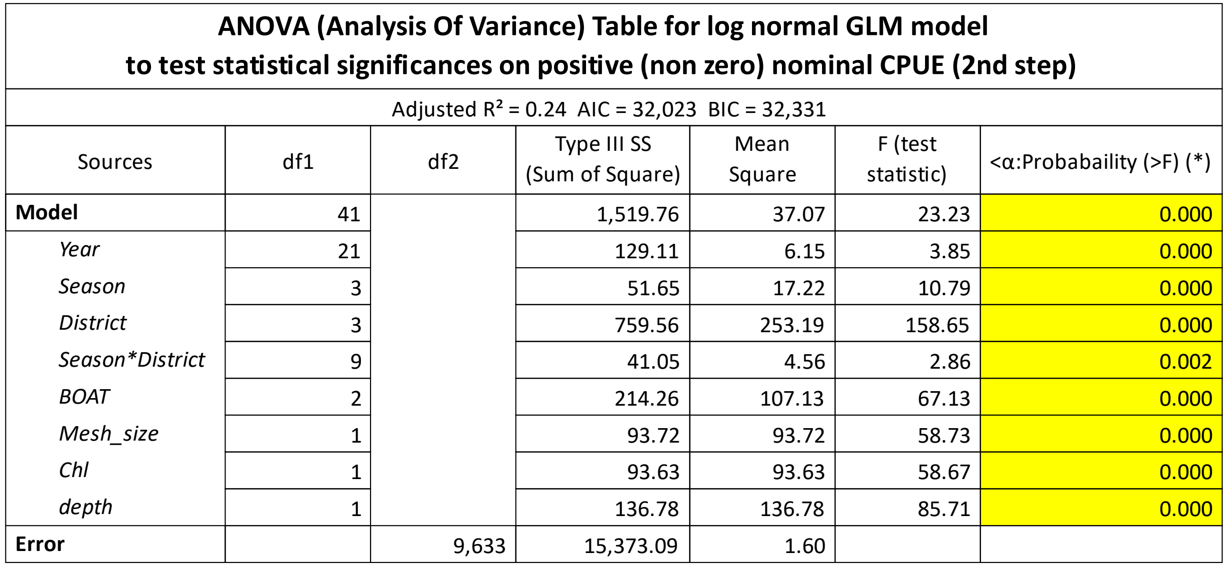
② 2nd ANOVA Table (non-0 CPUE)

if Pr. < 0.05 for model
➔log normal GLM OK

This example OK

Covariates
if NS (non significant)
➔ remove or keep

See next slide for detail explanations.



ANOVA (Analysis Of Variance) Table for log normal GLM model
to test statistical significances on positive (non zero) nominal CPUE (2nd step)

Adjusted R^2 = 0.24 AIC = 32,023 BIC = 32,331

Sources	df1	df2	Type III SS (Sum of Square)	Mean Square	F (test statistic)	<α:Probabaility (>F) (*)
Model	41		1,519.76	37.07	23.23	0.000
Year	21		129.11	6.15	3.85	0.000
Season	3		51.65	17.22	10.79	0.000
District	3		759.56	253.19	158.65	0.000
*Season*District*	9		41.05	4.56	2.86	0.002
BOAT	2		214.26	107.13	67.13	0.000
Mesh_size	1		93.72	93.72	58.73	0.000
Chl	1		93.63	93.63	58.67	0.000
depth	1		136.78	136.78	85.71	0.000
Error		9,633	15,373.09	1.60		

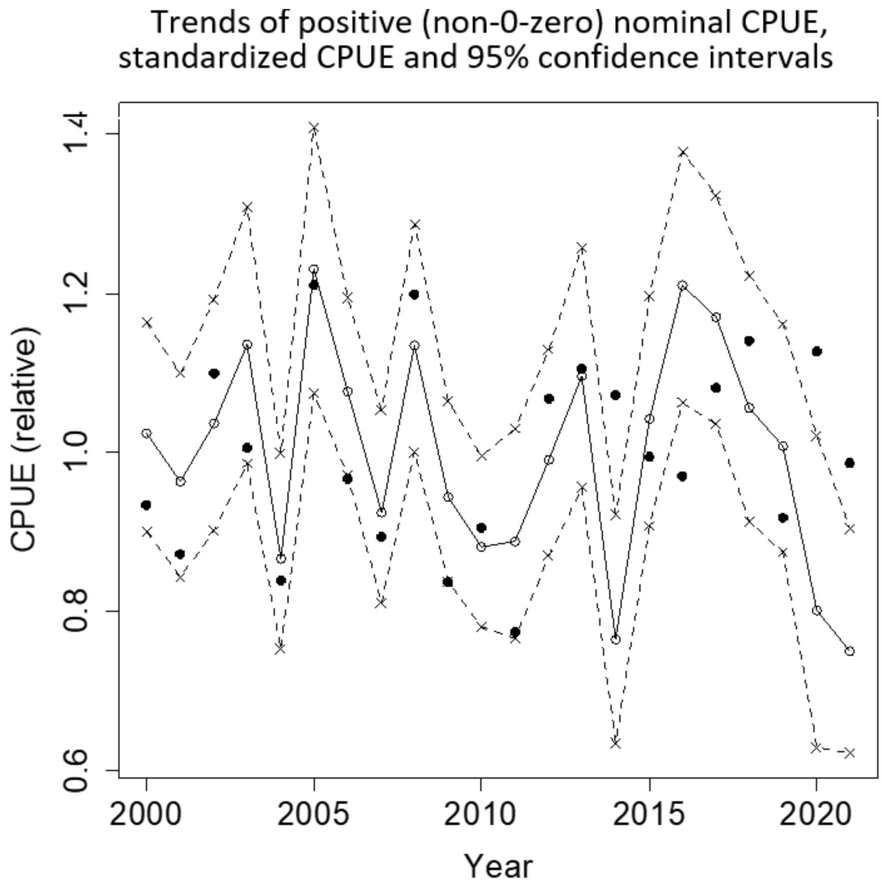
In this example, all are significant.
3 strong covariates bias nominal CPUE
(by order of F values)
➔ District, depth & Boat size

Explanatory note: ANOVA (log normal GLM for non 0 CPUE)

- The ANOVA table shows which covariates (such as year, Q, area, etc.) statistically affect non-0 nominal CPUE and whether log normal GLM is statistically significant (acceptable)
- If the covariates have an effect and the model is acceptable, they are indicated by yellow markers.
- If almost all covariates are not significant and/or Model (log normal GLM for non 0-CPUE) is not acceptable, try log normal GLM (including 0 CPUE) available in this software.
- If still NG, use nominal CPUE as an approximation.
- Please note that users need to mention such problems in their papers and also mention that results (CPUE standardization and stock assessments) should be treated with caution

*(Note) "Intercept" is not available in R used in this software, thus it is not shown in this ANOVA table***.** *However, "Intercept" does not relate to acceptance of the model.*

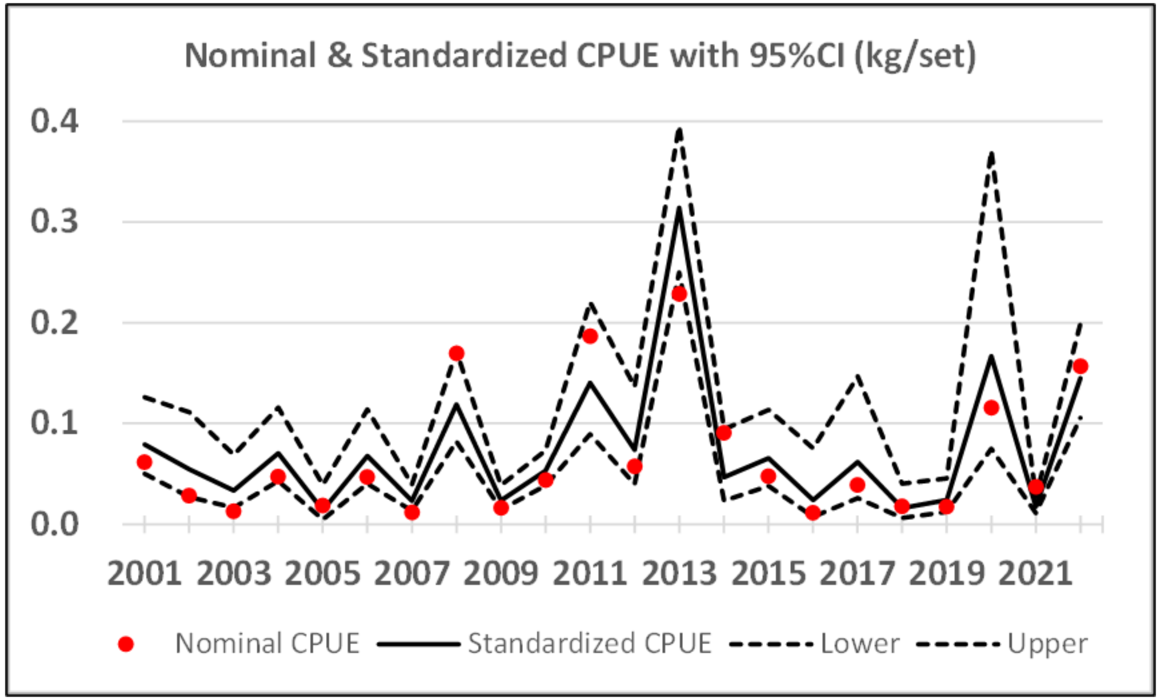
5.4.2 Implementing CPUE standardization（Delta model）
Output(3) Report (word) file



Legend

Point (•) : Positive (non-0-zero) nominal CPUE
Line (o—o) : Standardized positive (non-0-zero) CPUE (point estimate)
Dotted line (×—×) : 95% Confidence intervals

③ Annual trends of Nominal CPUE
& Standardized CPUE with 95% CI
(left: software output)
(right: Excel processed graph
based on different data set just for demo purpose)



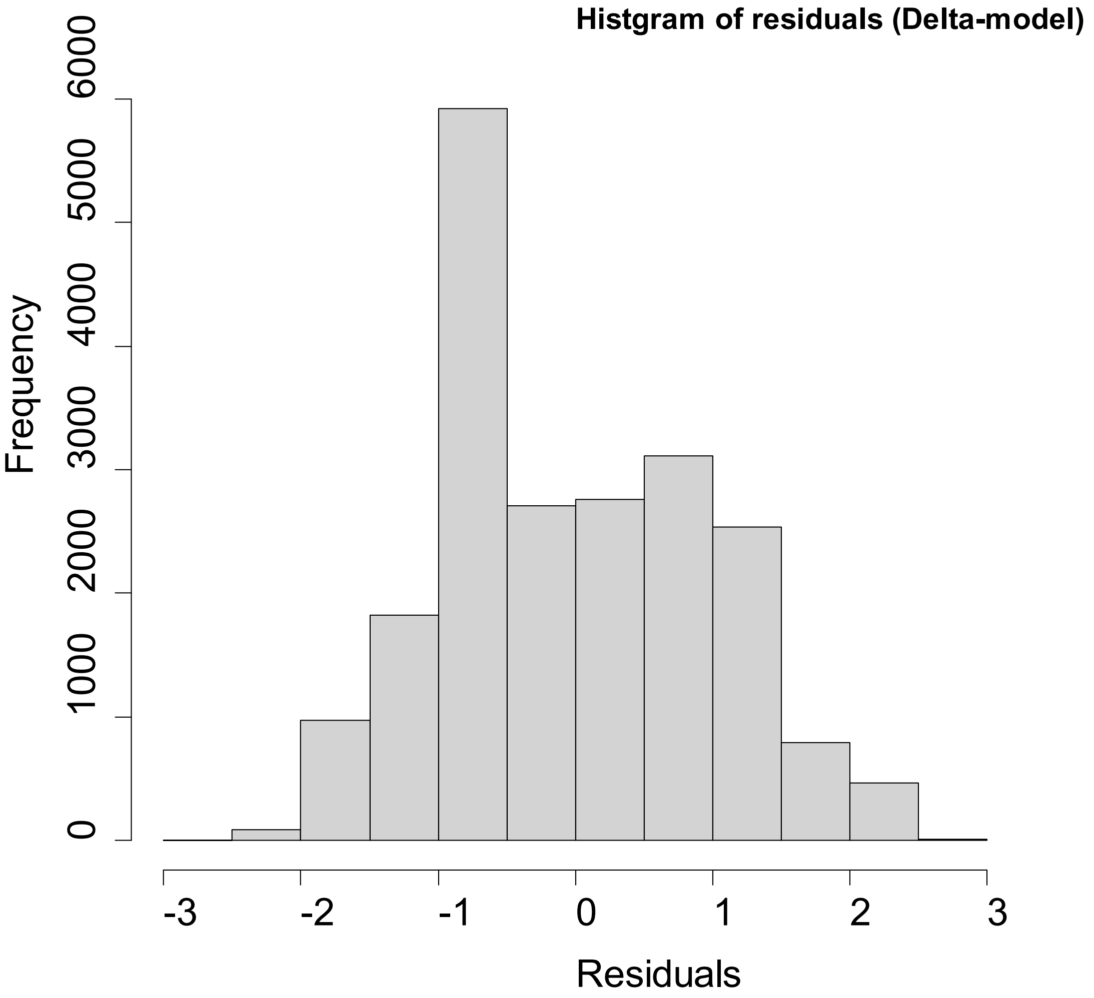
5.4.2 Implementing CPUE standardization（Delta model）
Output(3) : Report (word) file

④-1
Evaluation (1st step)
delta normal
(Residual analyses)

if binominal (or normal)
distribution is formed,

binominal model is OK

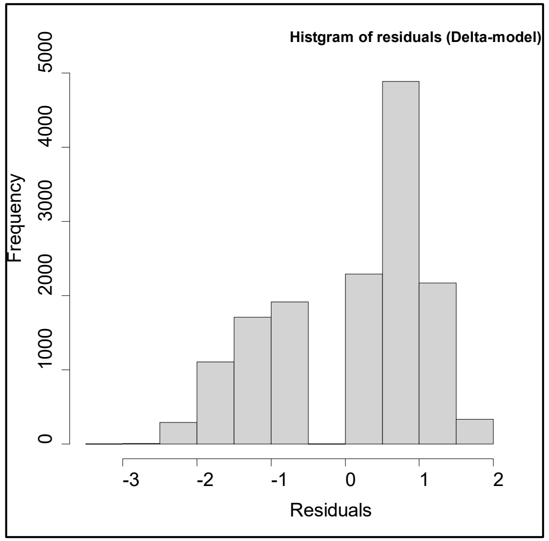
(see next slide for details)

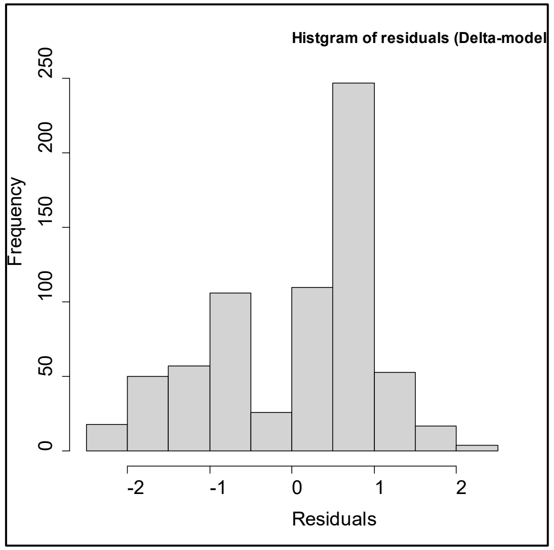


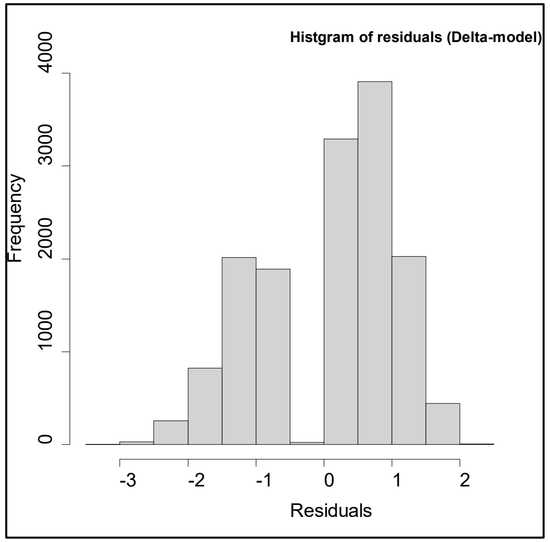
Explanatory note: Histogram of 0 CPUE rate residuals

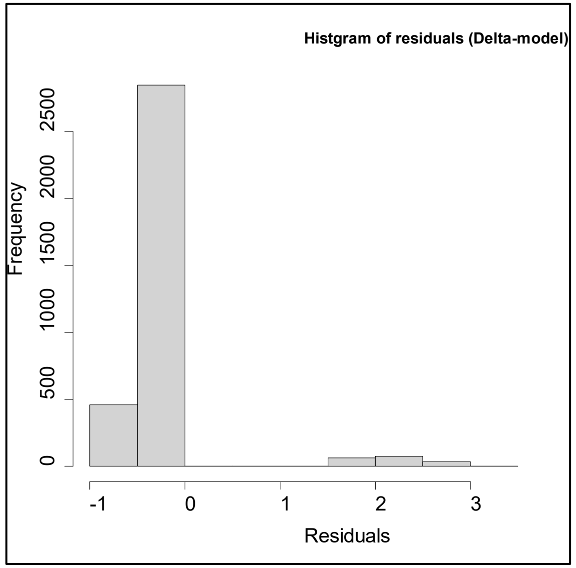
- If the frequency distribution of the 0 CPUE rate residuals (differnces between obserbed 0 CPUE and predicted CPUE) form binomial (or, as an approximation, a bell-shaped normal distribution), then the Zero inflated Delta 2 steps log normal GLM (delta model) is statistically acceptable.
- However, if strange patterns (see next slide) are formed, which happens when sample sizes are not enough, it is still Ok as patterns of error distributions of delta model are not as critical.
- Users need to proceed to the next step, which is to check the statistical validation of log-normal GLM for non 0-CPUE.

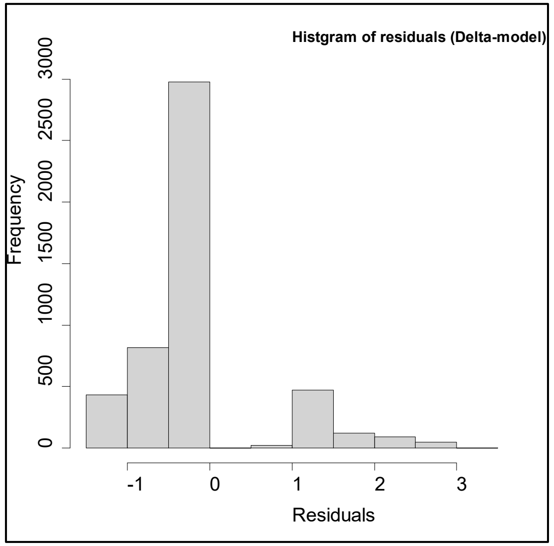
Strange patterns (binominal distribution) (see the previous slide)

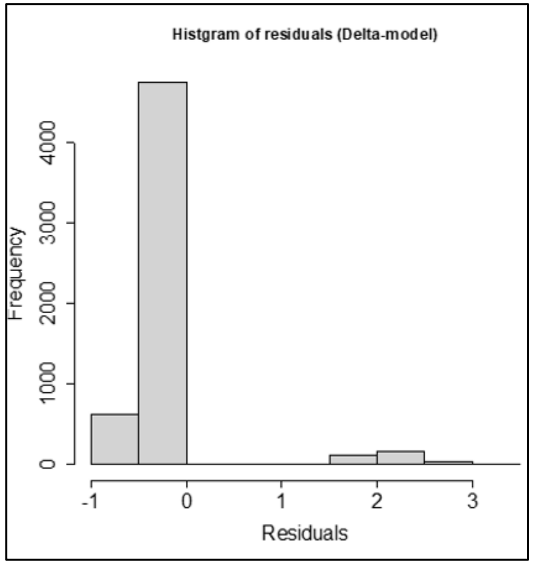












5.4.2 Implementing CPUE standardization（Delta model）
Output(3): Report (word) file

④-1

Evaluation (2nd step)

non 0 CPUE

log normal GLM

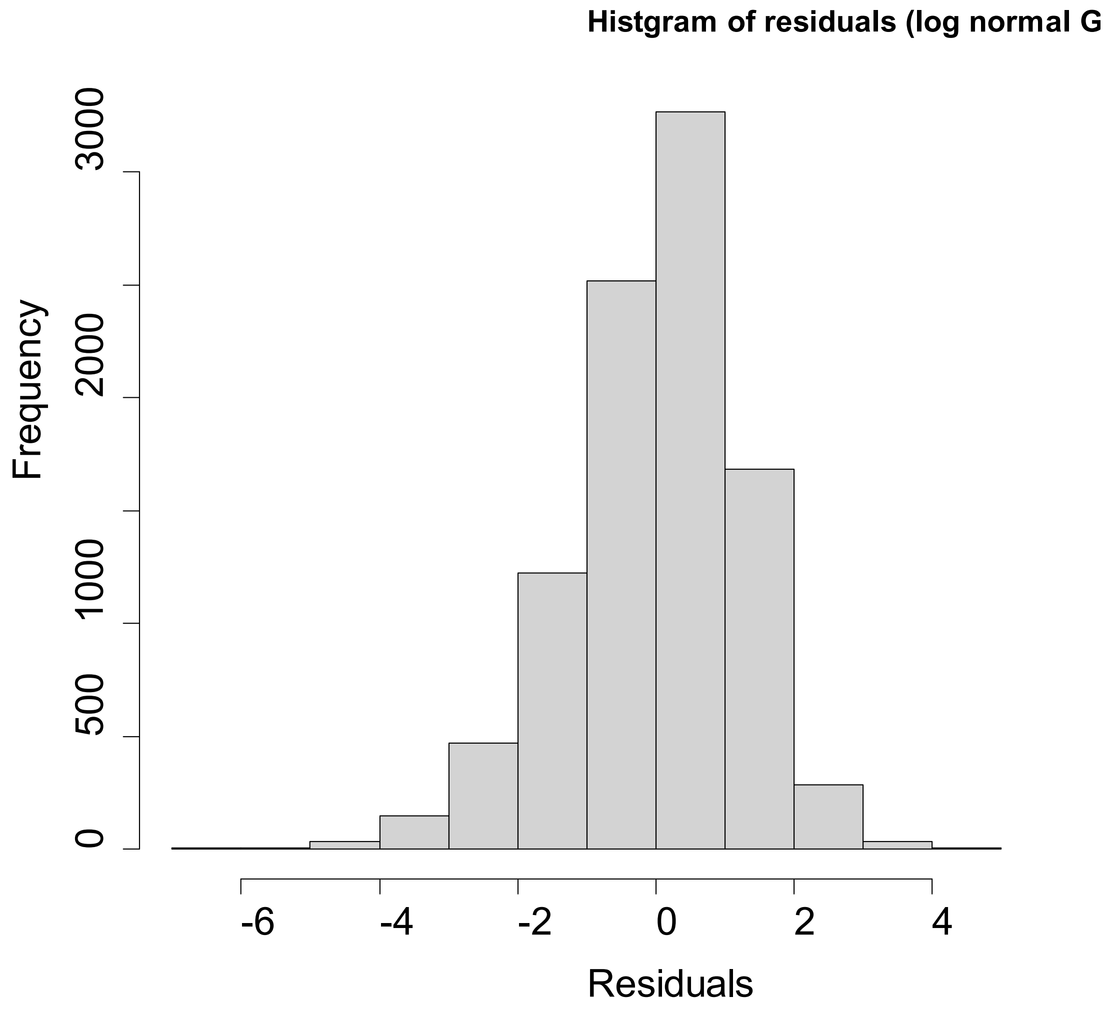
(Residual analyses)

if Bell shape

↓

model is OK

if not, change model



Explanatory note：Histogram of non 0 (zero) CPUE

- If the frequency distribution of the non-zero (0) CPUE residuals (differnces between non 0 observed CPUE and predicted CPUE) forms the bell-shaped normal distributions, the log-normal GLM is statistically acceptable.
- If the normal distributions are not well formed, the log-normal GLM is not acceptable, try another model (for example, log normal GLM including 0 CPUE available in this software).
- If still NG, use nominal CPUE as an approximate.
- Please note that users need to mention such problems in their papers and also remark that results (CPUE standardization and stock assessments) should be treated with caution.

5.4.2 Implementing CPUE standardization (Delta model）
Output(3) : Report (word) file

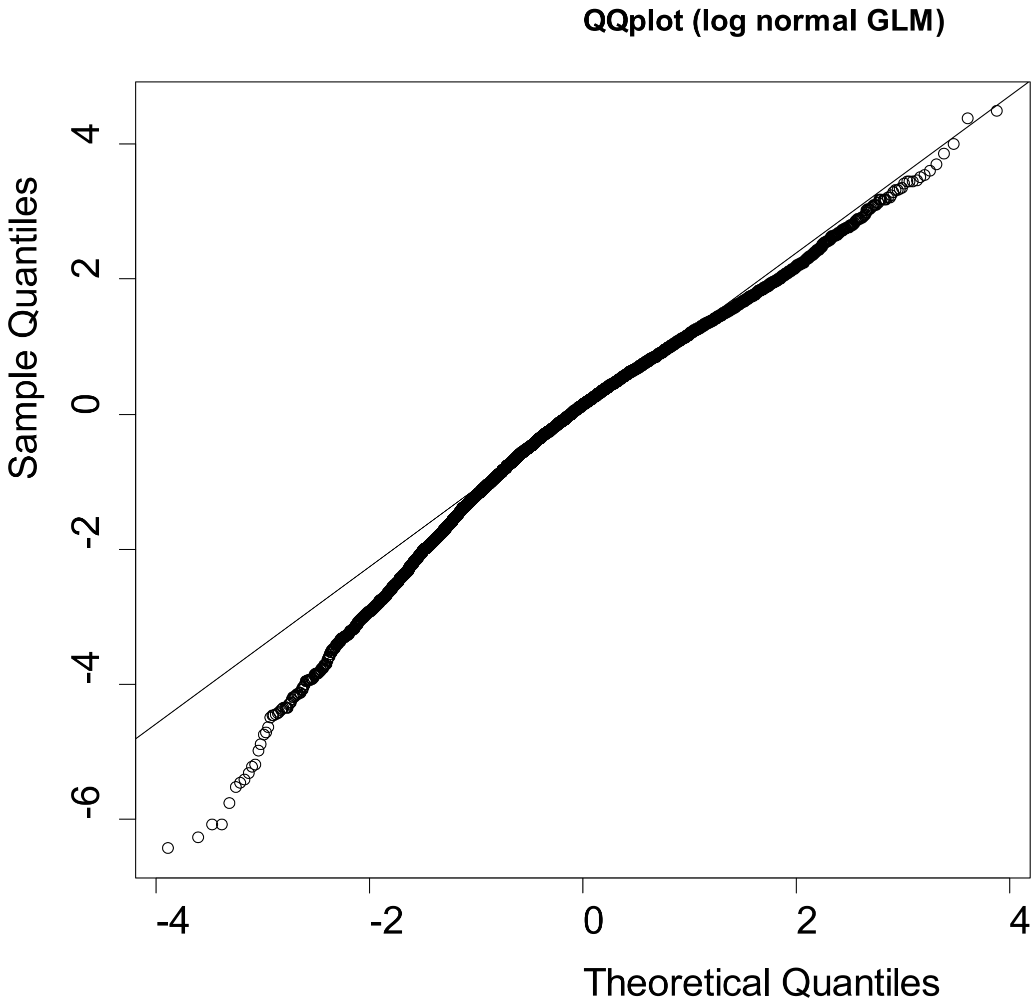
④-2

Evaluation of log normal GLM model (non 0 CPUE)
(Residual analysis)
QQ plot

If residuals close to the straight line

Model is OK

if not, change model
(see next slide)

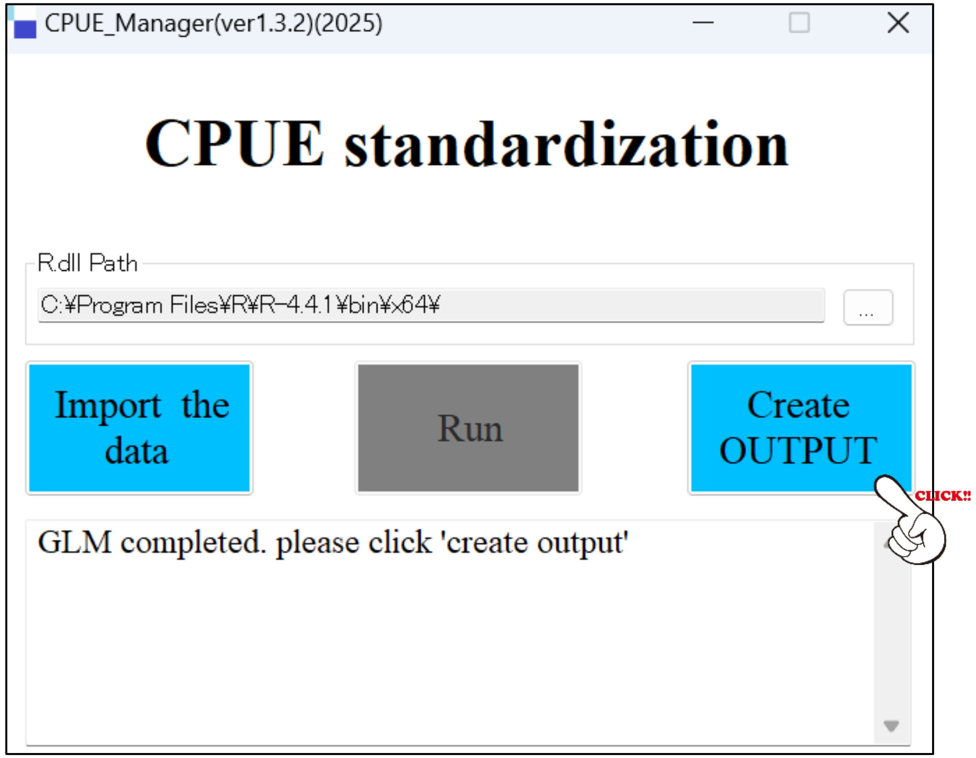


Explanatory note: QQ plot for non 0 CPUE

- A QQ (quantile-quantile) plot is a scatterplot created by plotting two sets of quantiles against each other.
- If both sets of quantiles came from the same distribution, we should see that the points form an approximately straight line.
- Therefore, if the actual QQ plot is close to a straight line, the log normal GLM (for non 0 CPUE) is acceptable.
- However, if both ends of the scatterplots are far from the line (for example, more than ± 4) and/or strange patterns are formed, log-normal GLM (for non 0 CPUE) is not acceptable and another model (log normal GLM including 0 CPUE available in this software) can be tried.
- If still NG, use nominal CPUE as an approximation.
- Please note that users must mention such problems in their papers and also indicate that the results (CPUE standardization and stock assessments) should be treated with caution.

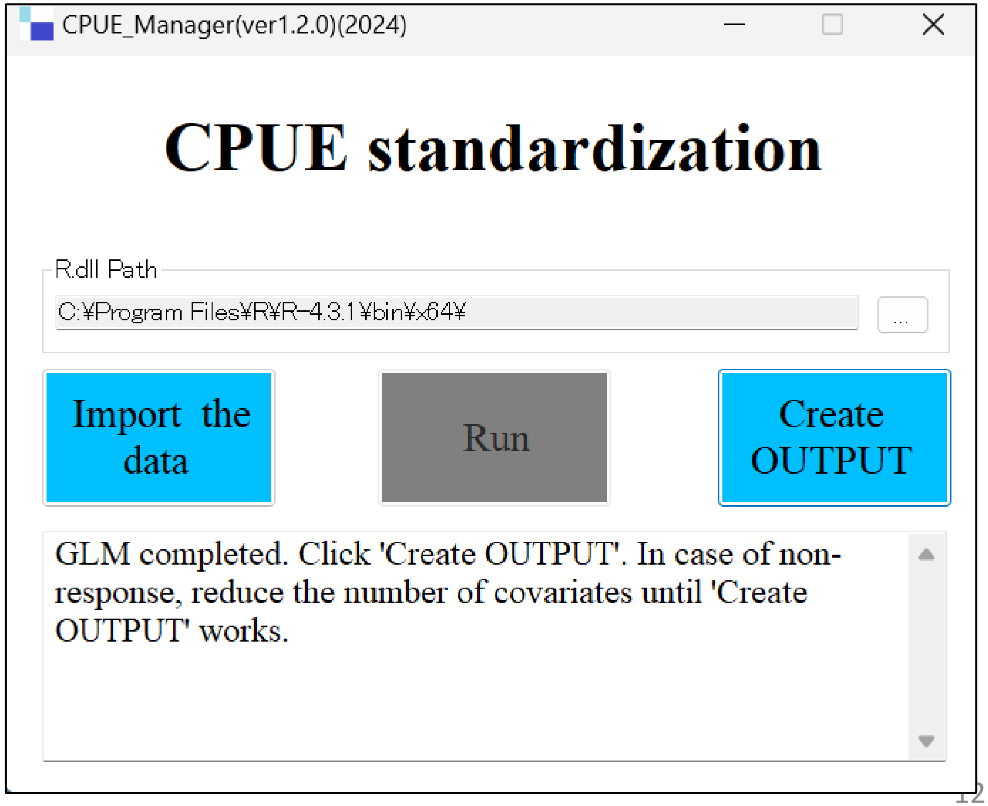
5.4.2 Implementing CPUE standardization(Delta model)
In case of non-response after clicking Create OUTPUT

If, after 'Import Data' & 'Run' have been completed successfully, there are no responses from ‘Create OUTPUT' even after clicking, then reduce the number of covariates until ‘Create OUTPUT' works. This will happen if the sample size is too small for some covariates.



C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

GLM completed. please click 'create output'

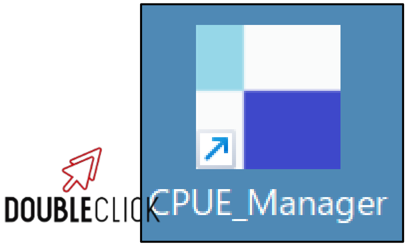


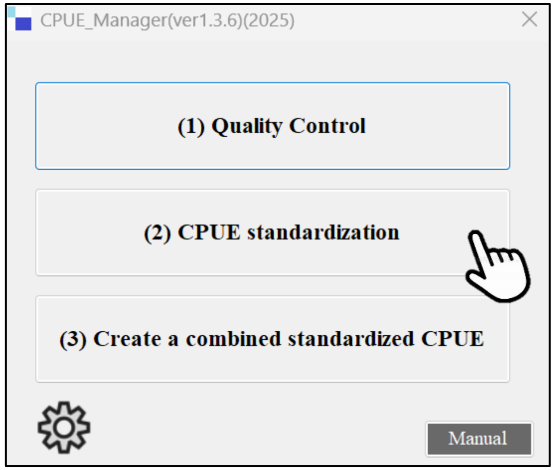
C:¥Program Files¥R¥R-4.3.1¥bin¥x64¥

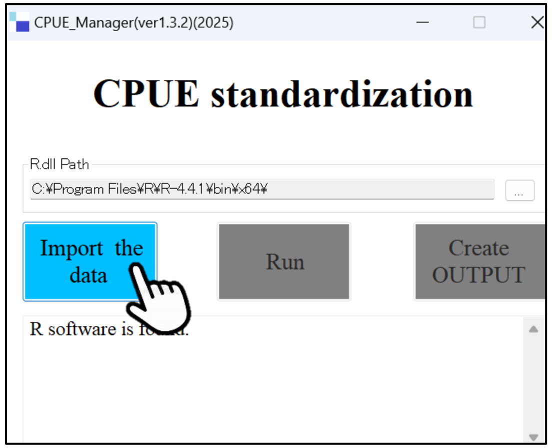
GLM completed. Click 'Create OUTPUT'. In case of non-response, reduce the number of covariates until 'Create OUTPUT' works.

5.4.2 Implementing CPUE standardization(Delta model) : Summary

5.4.2 Implementing CPUE standardization(Delta model) : Steps

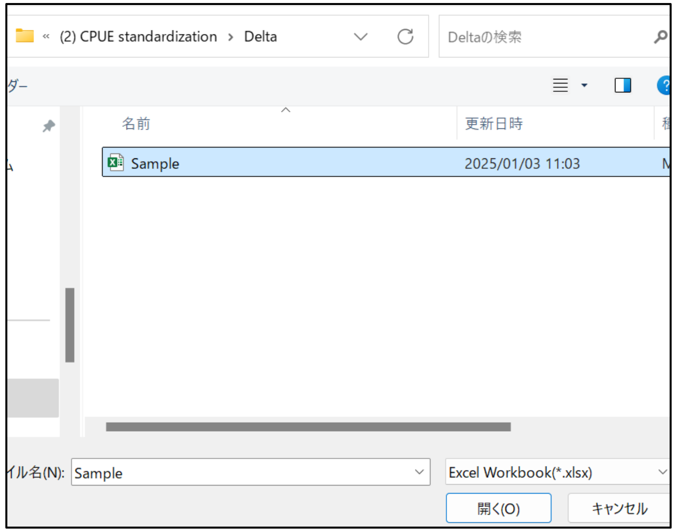






Rdll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

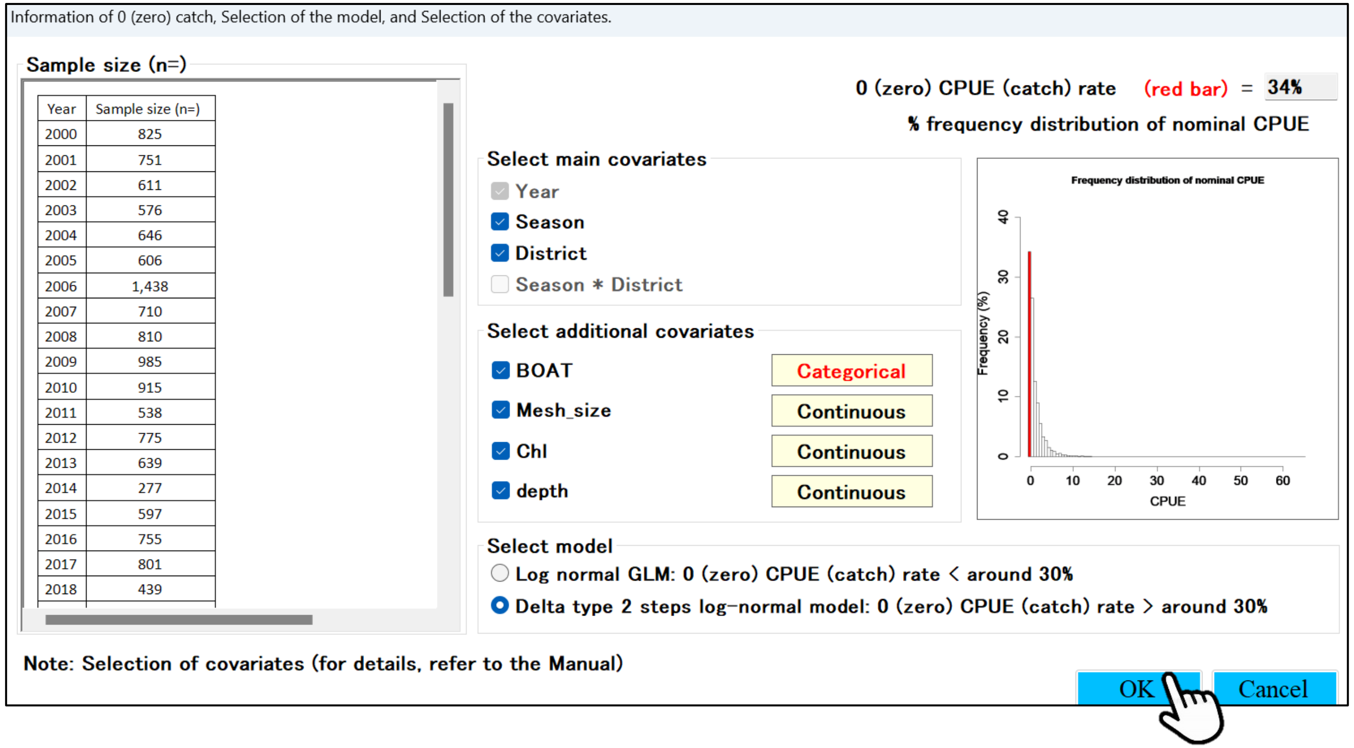
R software is fo d.



Sample 2025/01/03 11:03

イル名(N): Sample

Excel Workbook(*.xlsx)



Information of 0 (zero) catch, Selection of the model, and Selection of the covariates.

Sample size (n=)

Year	Sample size (n=)
2000	825
2001	751
2002	611
2003	576
2004	646
2005	606
2006	1,438
2007	710
2008	810
2009	985
2010	915
2011	538
2012	775
2013	639
2014	277
2015	597
2016	755
2017	801
2018	439

0 (zero) CPUE (catch) rate (red bar) = 34%

% frequency distribution of nominal CPUE

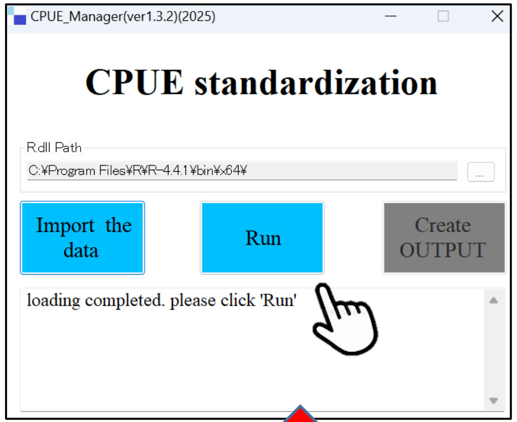
Select main covariates
- ☑ Year
- ☑ Season
- ☑ District
- ☐ Season * District

Select additional covariates

☑ BOAT	Categorical
☑ Mesh_size	Continuous
☑ Chl	Continuous
☑ depth	Continuous

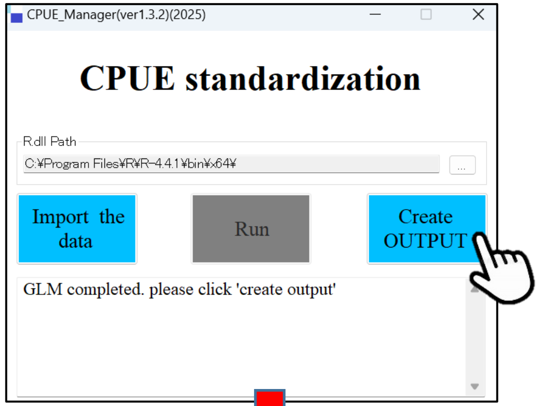
Select model
- ○ Log normal GLM: 0 (zero) CPUE (catch) rate < around 30%
- ● Delta type 2 steps log-normal model: 0 (zero) CPUE (catch) rate > around 30%

Note: Selection of covariates (for details, refer to the Manual)



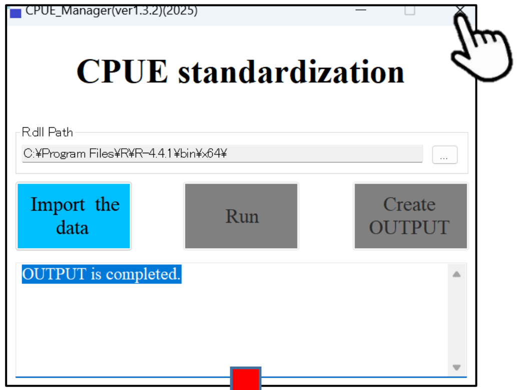
Rdll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

loading completed. please click 'Run'



Rdll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

GLM completed. please click 'create output'



Rdll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

OUTPUT is completed.

3 output files are created in users' working folder.

5.5 Problems and Solutions

Users will sometimes face 4 problems below. Solutions are explained.

(1) Process error

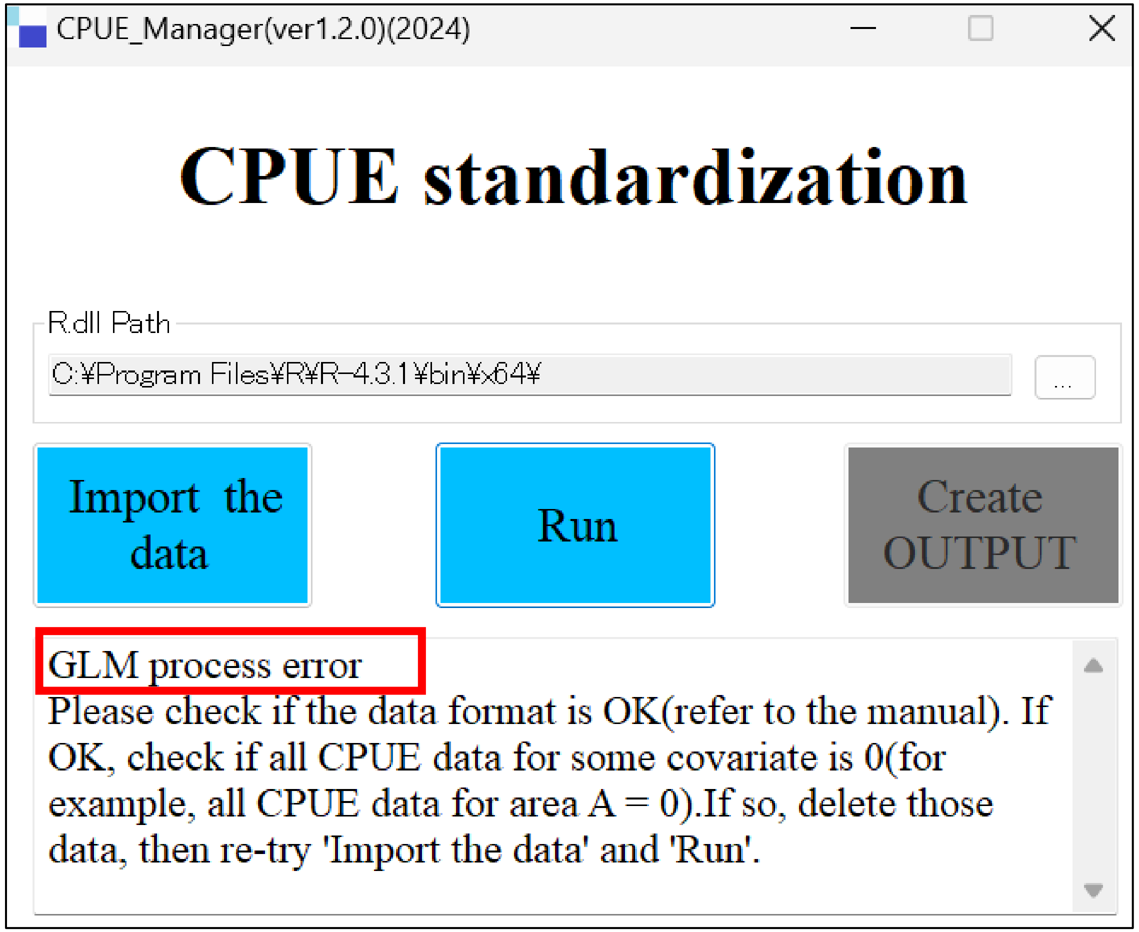
(2) Non-response after clicking Create OUTPUT

(3) Standardized CPUE are not estimated

(4) Multi-collinearity (Delta)

(1) Process error

Users will see "Process error" message (below) if input data has some problems. In such case, follow the instruction and re-try again.



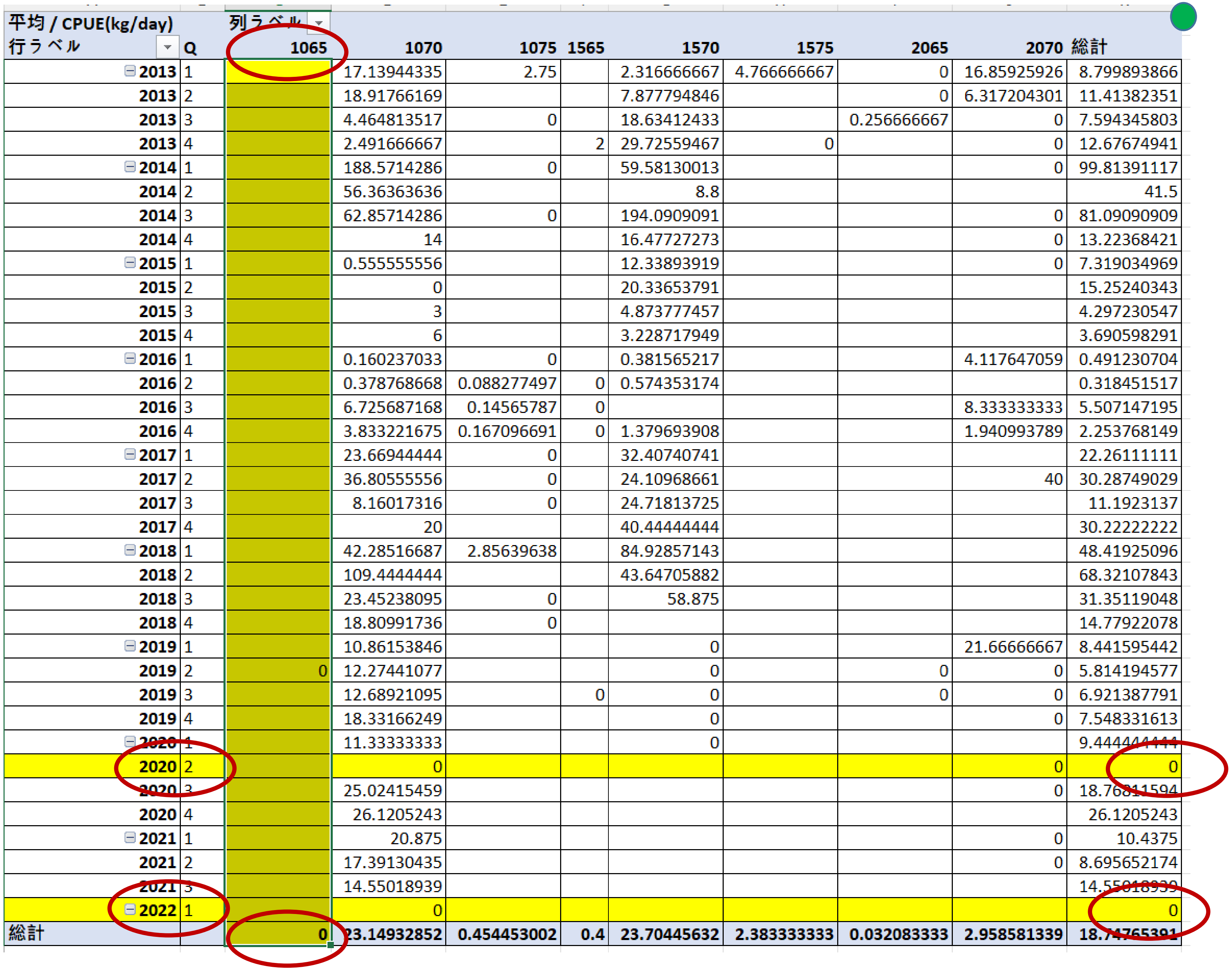
GLM process error
Please check if the data format is OK(refer to the manual). If OK, check if all CPUE data for some covariate is 0(for example, all CPUE data for area A = 0).If so, delete those data, then re-try 'Import the data' and 'Run'.

See some example
(next slide)

To investigate causes of error, make a pivot Table of 3 Covariate (year, quarter & area number) (see right)

There are some techniques to make this pivot table.
If you need help,
(a) check the excel manual,
(b) ask your colleagues or
(c)ask [MENU].

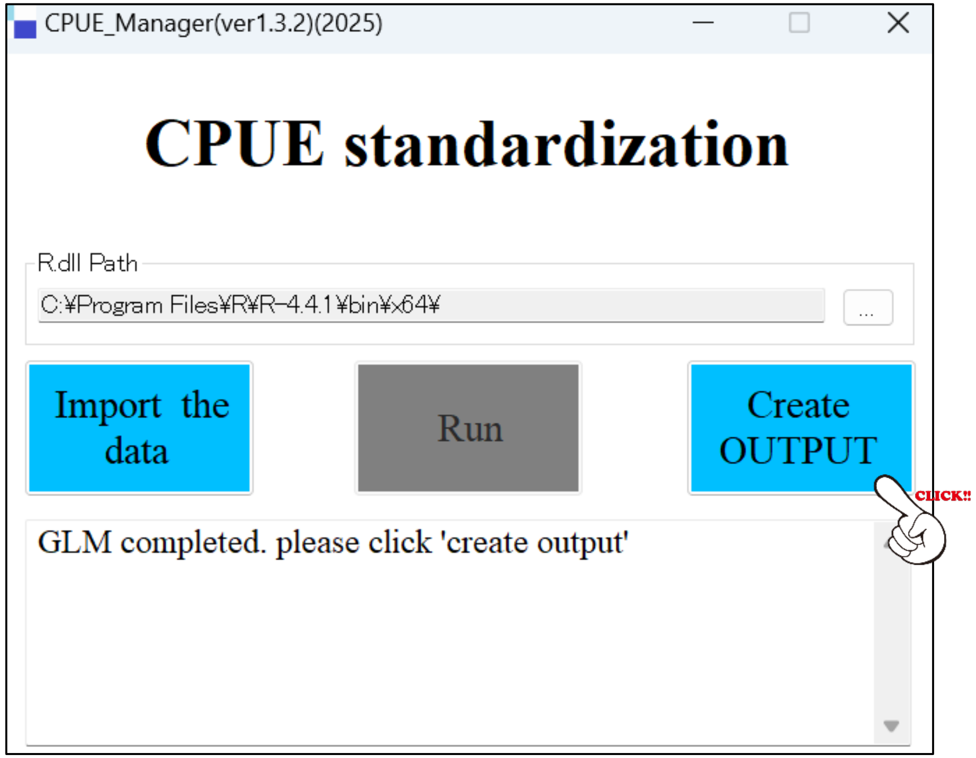
In this case, covariates, area(1065), year & Q (2020 Q2) and (2022 Q1) need to delete as their values =0



平均 / CPUE(kg/day)		列ラベル								
行ラベル	Q	1065	1070	1075	1565	1570	1575	2065	2070	総計
⊟2013	1		17.13944335	2.75		2.316666667	4.766666667	0	16.85925926	8.799893866
2013	2		18.91766169			7.877794846		0	6.317204301	11.41382351
2013	3		4.464813517	0		18.63412433		0.256666667	0	7.594345803
2013	4		2.491666667		2	29.72559467	0		0	12.67674941
⊟2014	1		188.5714286	0		59.58130013			0	99.81391117
2014	2		56.36363636			8.8				41.5
2014	3		62.85714286	0		194.0909091			0	81.09090909
2014	4		14			16.47727273			0	13.22368421
⊟2015	1		0.555555556			12.33893919			0	7.319034969
2015	2		0			20.33653791				15.25240343
2015	3		3			4.873777457				4.297230547
2015	4		6			3.228717949				3.690598291
⊟2016	1		0.160237033	0		0.381565217			4.117647059	0.491230704
2016	2		0.378768668	0.088277497	0	0.574353174				0.318451517
2016	3		6.725687168	0.14565787	0				8.333333333	5.507147195
2016	4		3.833221675	0.167096691	0	1.379693908			1.940993789	2.253768149
⊟2017	1		23.66944444	0		32.40740741				22.26111111
2017	2		36.80555556	0		24.10968661			40	30.28749029
2017	3		8.16017316	0		24.71813725				11.1923137
2017	4		20			40.44444444				30.22222222
⊟2018	1		42.28516687	2.85639638		84.92857143				48.41925096
2018	2		109.4444444			43.64705882				68.32107843
2018	3		23.45238095	0		58.875				31.35119048
2018	4		18.80991736	0						14.77922078
⊟2019	1		10.86153846			0			21.66666667	8.441595442
2019	2	0	12.27441077			0		0	0	5.814194577
2019	3		12.68921095		0	0		0	0	6.921387791
2019	4		18.33166249			0			0	7.548331613
⊟2020	1		11.33333333			0				9.444444444
2020	2		0						0	0
2020	3		25.02415459						0	18.76811594
2020	4		26.1205243							26.1205243
⊟2021	1		20.875						0	10.4375
2021	2		17.39130435						0	8.695652174
2021	3		14.55018939							14.55018939
⊟2022	1		0							0
総計		0	23.14932852	0.454453002	0.4	23.70445632	2.383333333	0.032083333	2.958581339	18.74765391

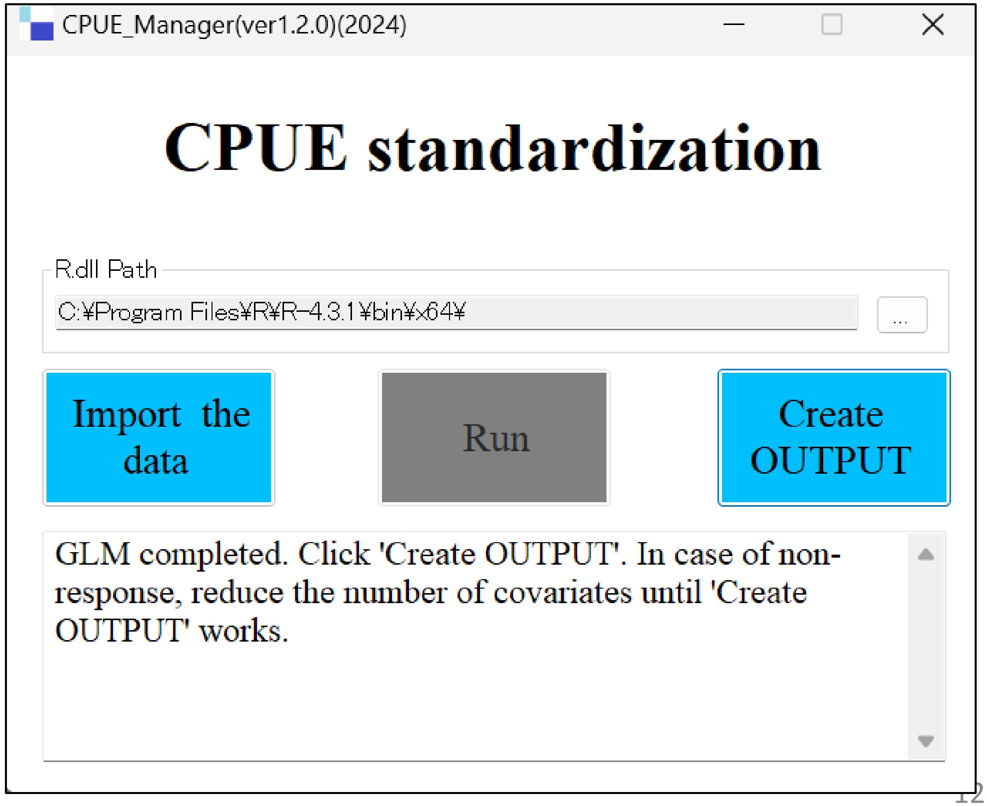
(2) Non-response after clicking Create OUTPUT

If, after 'Import Data' & 'Run' have been completed successfully, there are no responses from 'Create OUTPUT' even after clicking. To solve this problem, reduce the number of covariates until 'Create OUTPUT' works. This will happen if the sample size is too small for some covariates.



R.dll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

GLM completed. please click 'create output'

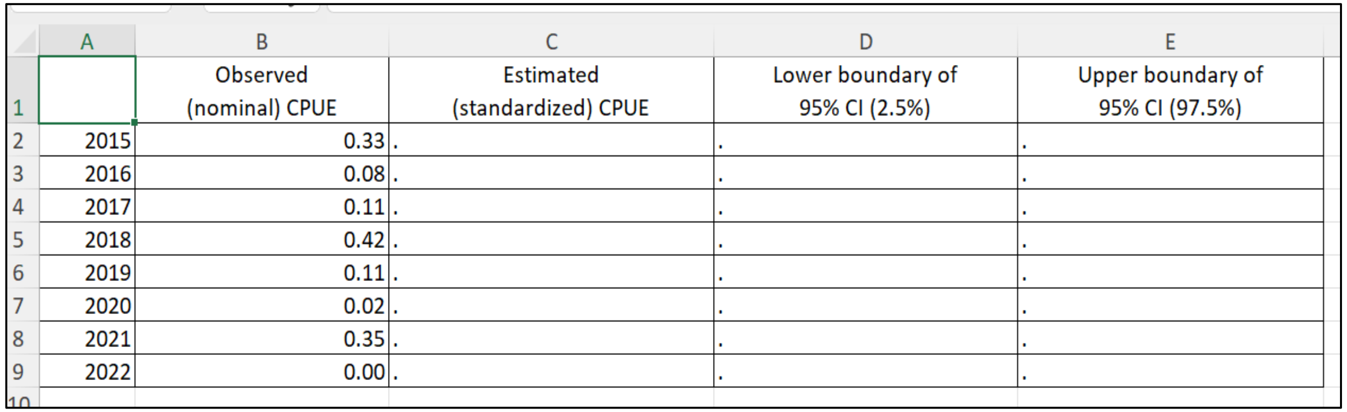


R.dll Path: C:¥Program Files¥R¥R-4.3.1¥bin¥x64¥

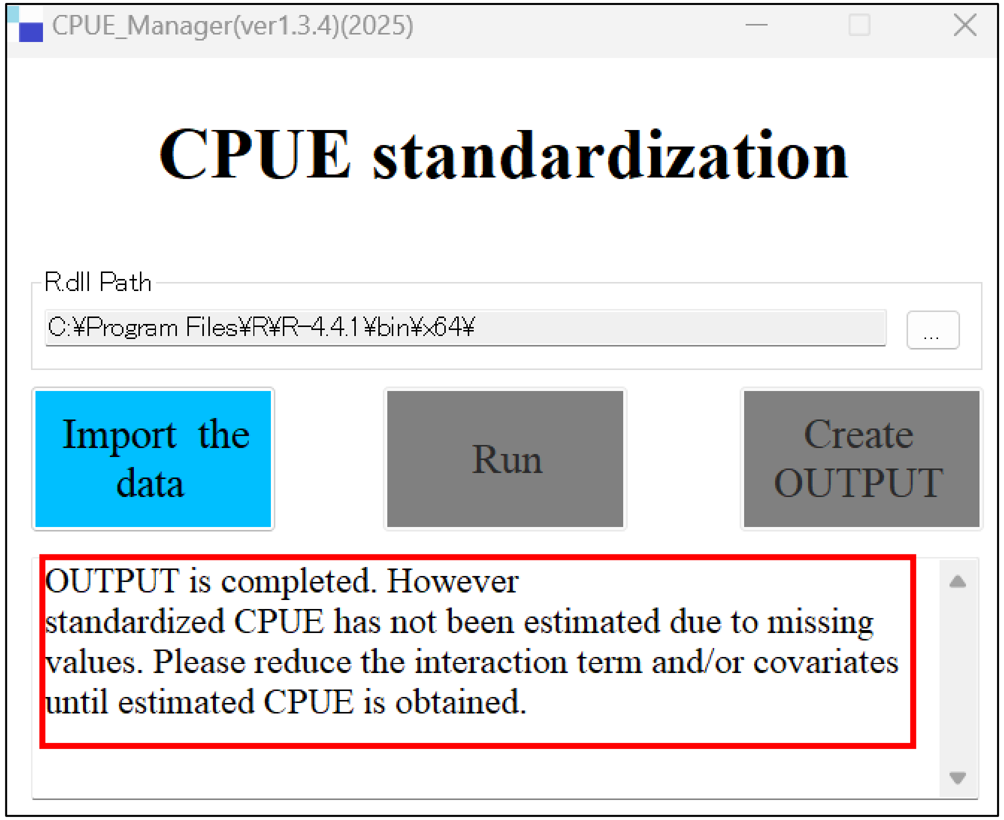
GLM completed. Click 'Create OUTPUT'. In case of non-response, reduce the number of covariates until 'Create OUTPUT' works.

(3) Standardized CPUE are not estimated

After all processes are successfully completed, sometimes standardized CPUE are not estimated. In such case, CPUE standardization window will provide the message (right).
To solve this problem, follow the instruction



	A	B	C	D	E
1		Observed (nominal) CPUE	Estimated (standardized) CPUE	Lower boundary of 95% CI (2.5%)	Upper boundary of 95% CI (97.5%)
2	2015	0.33	.	.	.
3	2016	0.08	.	.	.
4	2017	0.11	.	.	.
5	2018	0.42	.	.	.
6	2019	0.11	.	.	.
7	2020	0.02	.	.	.
8	2021	0.35	.	.	.
9	2022	0.00	.	.	.



R.dll Path: C:¥Program Files¥R¥R-4.4.1¥bin¥x64¥

OUTPUT is completed. However standardized CPUE has not been estimated due to missing values. Please reduce the interaction term and/or covariates until estimated CPUE is obtained.

(4) Multi-collinearity

Multicollinearity is the occurrence of high intercorrelations among two or more covariates in a multiple regression model.
If it occurs, the ANOVA table produces the warning (see example below).
In such case, if the interaction term (Q*atoll in the example) is removed, this problem will be solved.

ANOVA (Analysis Of Variance) Table for log normal GLM model
to test statistical significances on positive (non zero) nominal CPUE (2nd step)

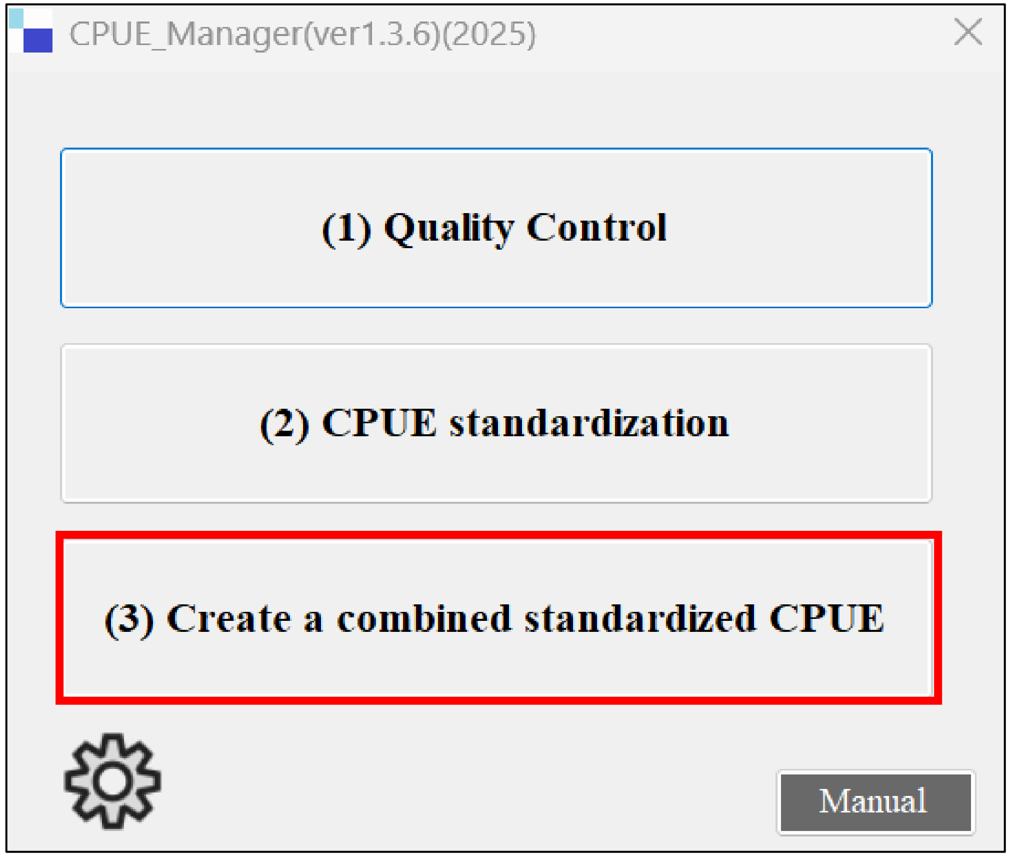
Adjusted $R^2 = 0.40$ AIC = 3,308 BIC = 3,754

Sources	df1	df2	Type III SS (Sum of Square)	Mean Square	F (test statistic)	<α:Probabaility (>F) (*)
Year	14		91.47	6.53	4.44	0.000
Q	0		(warning)	(warning)	(warning)	(warning)
atoll	18		336.79	18.71	12.73	0.000
*Q*atoll*	51		130.28	2.55	1.74	0.001
Error		909	1,336.36	1.47		

(warning):Multi-collinearity problem(remove interaction term)

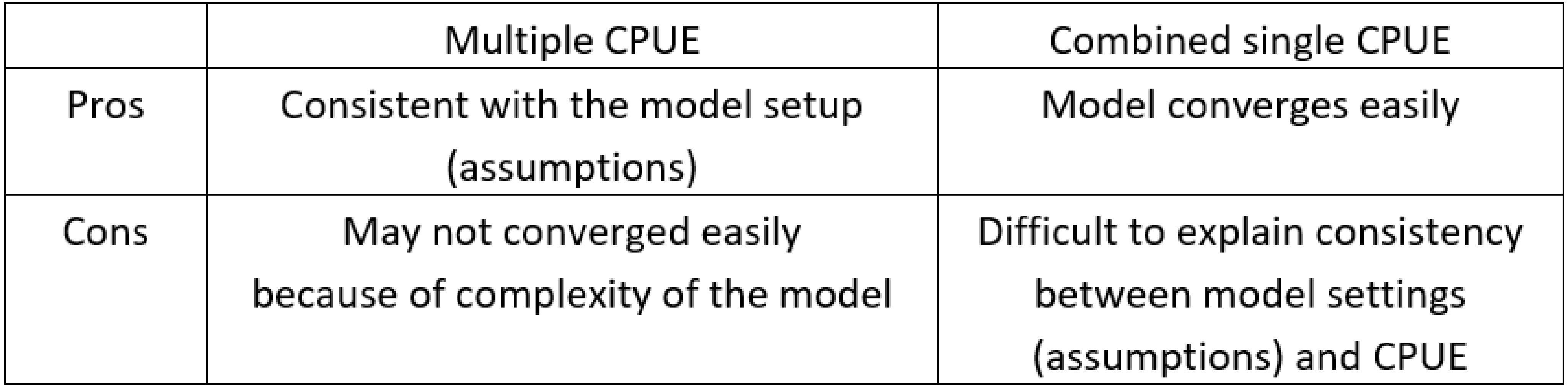
6. [3rd menu] Creating one common standardized CPUE

6. [3rd menu] Creating one common standardized CPUE



6. [3rd menu] Creating one common standardized CPUE

If multiple CPUE is available, which CPUE should be used in production models, "One average CPUE" or "Multiple CPUE"? : Pros and Cons



	Multiple CPUE	Combined single CPUE
Pros	Consistent with the model setup (assumptions)	Model converges easily
Cons	May not converged easily because of complexity of the model	Difficult to explain consistency between model settings (assumptions) and CPUE

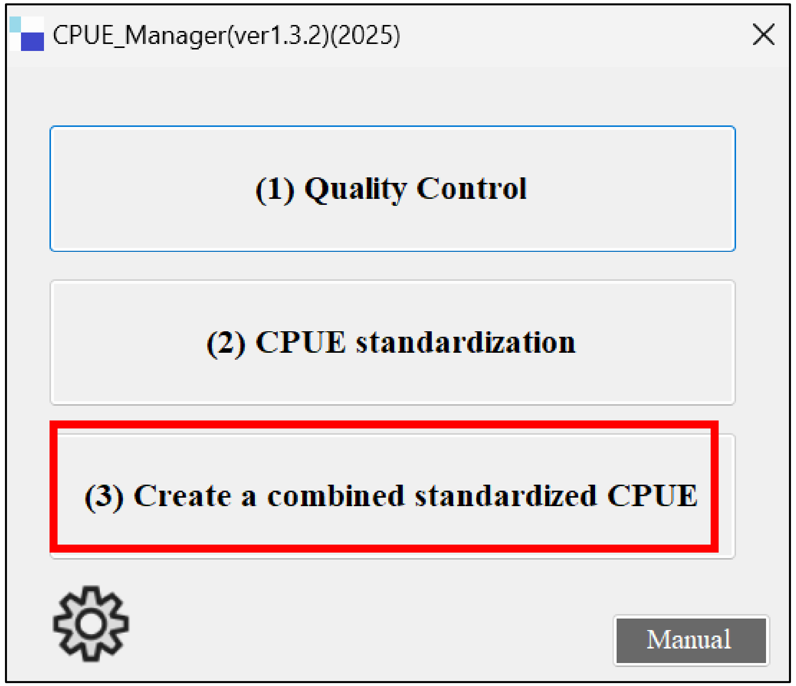
ASPIC➔ Difficulty in achieving convergence in the case of multiple CPUE due to lack of data and/or complexity as a simple model. Therefore, a combined CPUE (weighted average by catch) is often used as an alternative.

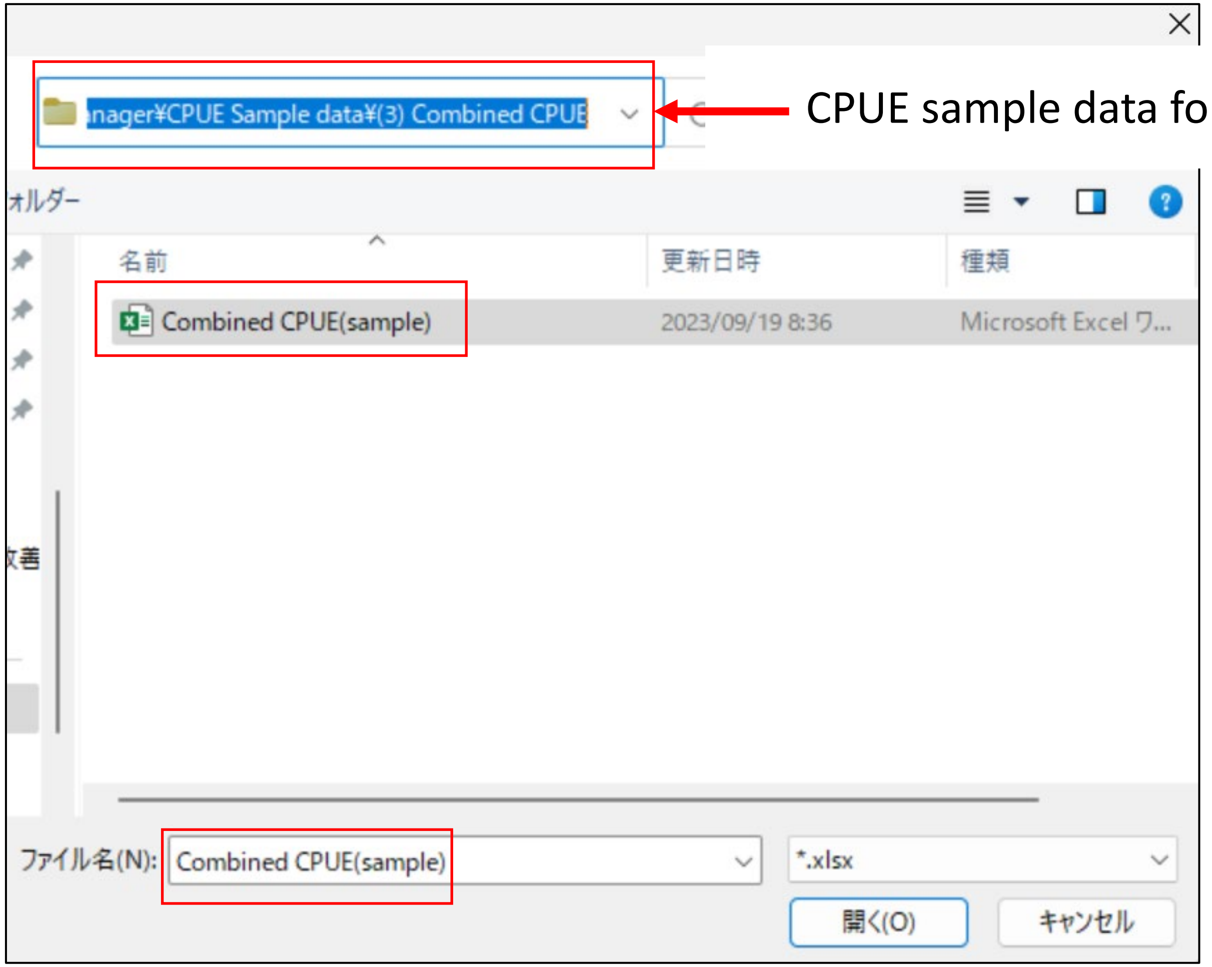
JABBA➔ Can handle better than ASPIC with technical treatments.

6. [3rd menu] Creating one common standardized CPUE
Preparation of multiple CPUE & Catch data sets (see sample data below)

	CPUE1	Catch 1	CPUE2	Catch 2	CPUE3	Catch 3
2011	1.27	13128	1.14	24	.	454654
2012	2.04	9797	0.59	435	1.98	223
2013	.	2308	1.57	354	0.93	23243
2014	0.98	2987	0.62	76	.	8856
2015	1.15	4523	1.14	43534	1.16	64564
2016	1.22	243432	1.84	354	1.47	54645
2017	.	9879	1.88	445	0.91	4654564
2018	0.96	9898	0.88	34	0.66	675
2019	0.69	65465	.	3543	1.21	68787
2020	1.27	4567	1.10	5654	0.62	3432
2021	0.65	876786	1.39	6876	1.66	345
2022	1.75	25443	.	123	0.65	34534
2023	0.69	98	0.62	234432	1.21	788978

6. [3rd menu] Creating one common standardized CPUE
Importing the data




nager¥CPUE Sample data¥(3) Combined CPUE

名前	更新日時	種類
Combined CPUE(sample)	2023/09/19 8:36	Microsoft Excel ワ...

ファイル名(N): Combined CPUE(sample)

*.xlsx

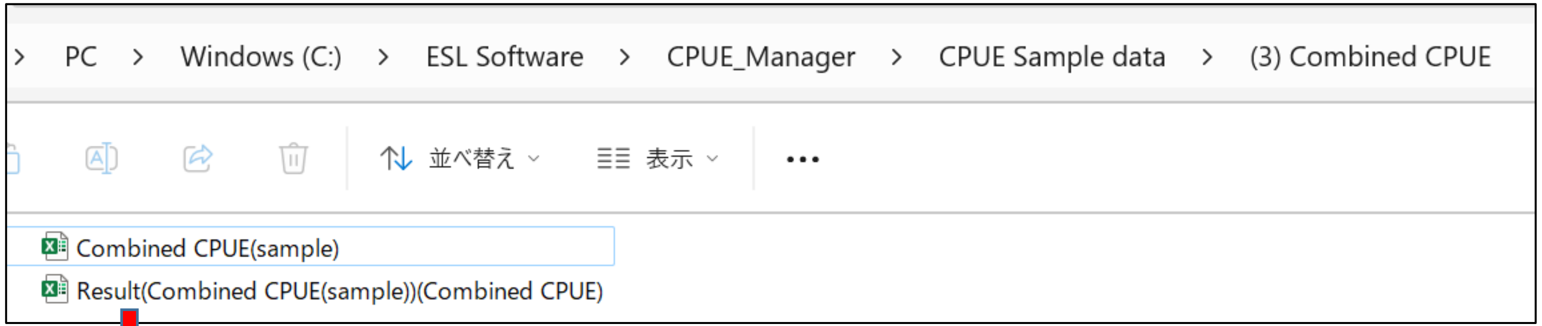
CPUE sample data folder

Importing the sample data (3 CPUE/Catch data sets)

6. [3rd menu]

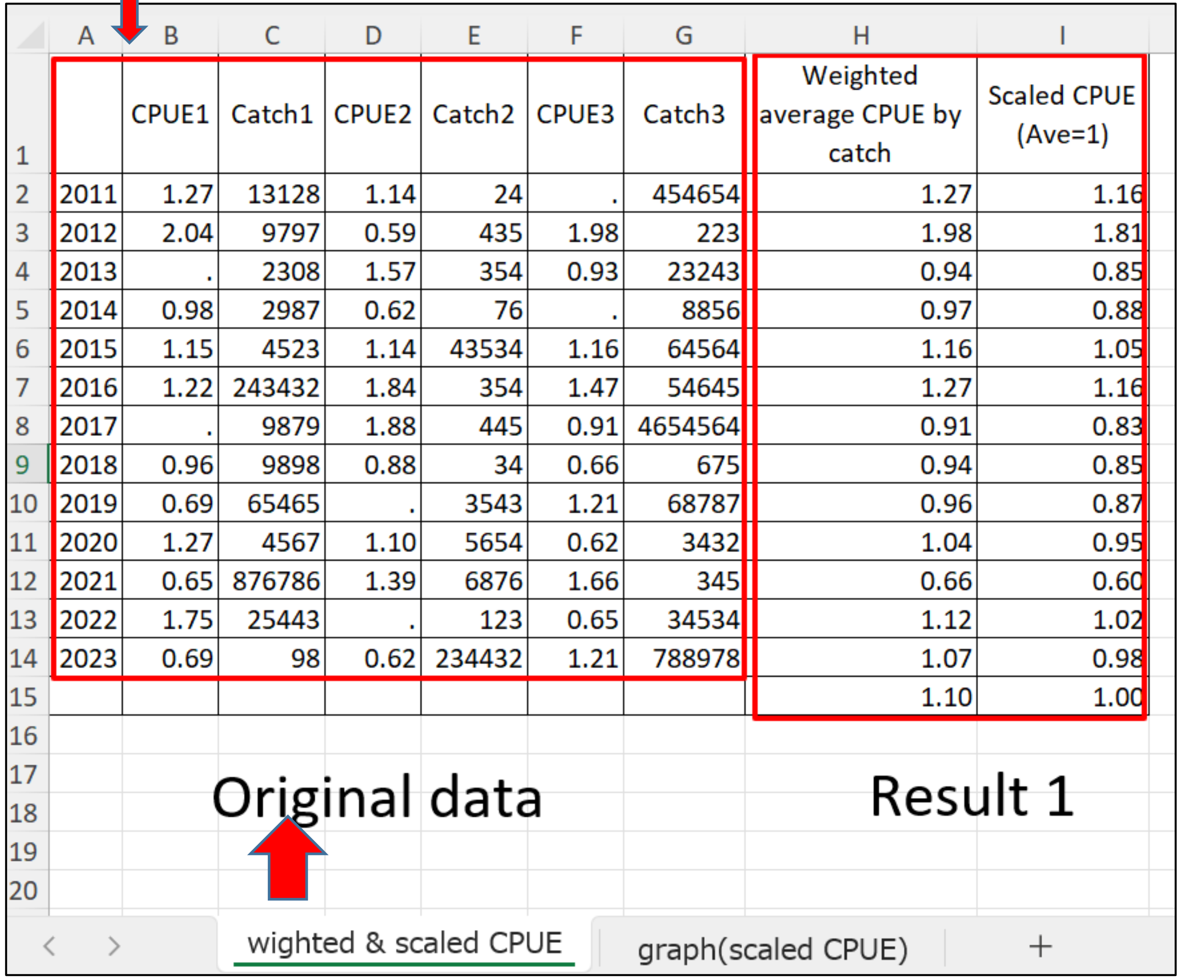
Creating one common standardized CPUE

Results
(1st sheet)
Weighted & scaled CPUE



> PC > Windows (C:) > ESL Software > CPUE_Manager > CPUE Sample data > (3) Combined CPUE

Combined CPUE(sample)
Result(Combined CPUE(sample))(Combined CPUE)



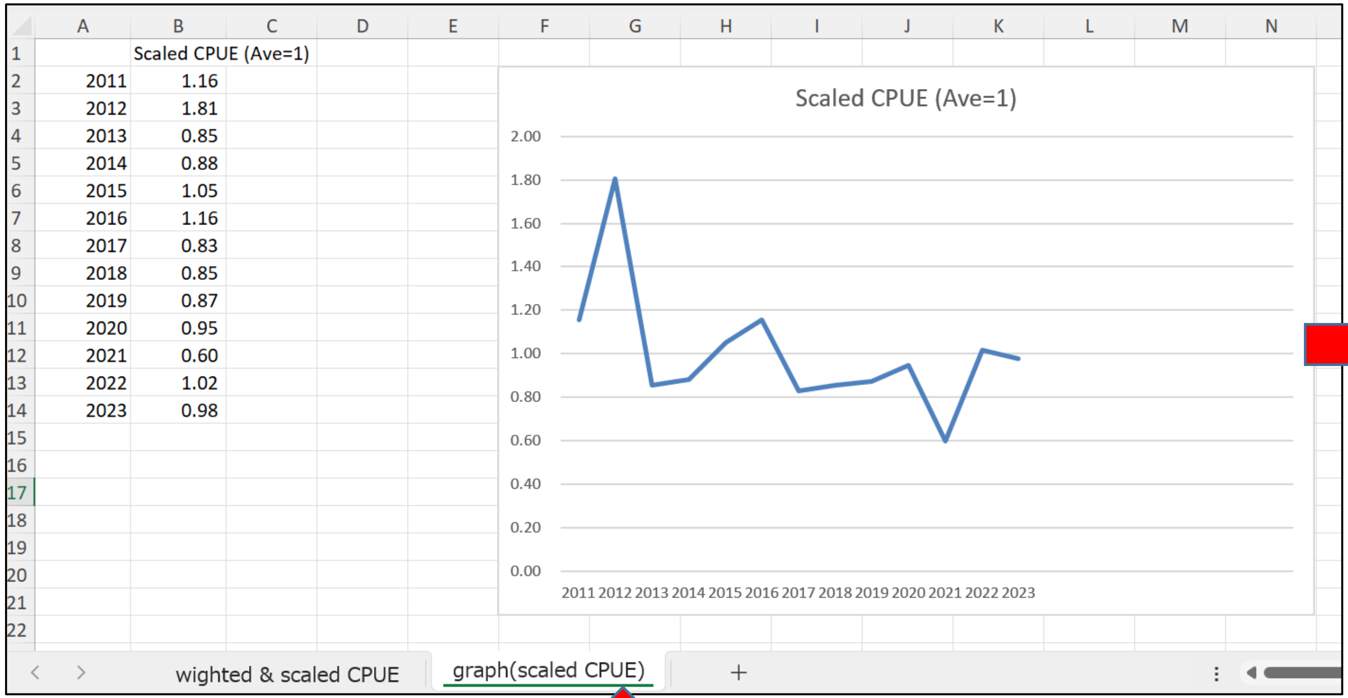
	CPUE1	Catch1	CPUE2	Catch2	CPUE3	Catch3	Weighted average CPUE by catch	Scaled CPUE (Ave=1)
2011	1.27	13128	1.14	24	.	454654	1.27	1.16
2012	2.04	9797	0.59	435	1.98	223	1.98	1.81
2013	.	2308	1.57	354	0.93	23243	0.94	0.85
2014	0.98	2987	0.62	76	.	8856	0.97	0.88
2015	1.15	4523	1.14	43534	1.16	64564	1.16	1.05
2016	1.22	243432	1.84	354	1.47	54645	1.27	1.16
2017	.	9879	1.88	445	0.91	4654564	0.91	0.83
2018	0.96	9898	0.88	34	0.66	675	0.94	0.85
2019	0.69	65465	.	3543	1.21	68787	0.96	0.87
2020	1.27	4567	1.10	5654	0.62	3432	1.04	0.95
2021	0.65	876786	1.39	6876	1.66	345	0.66	0.60
2022	1.75	25443	.	123	0.65	34534	1.12	1.02
2023	0.69	98	0.62	234432	1.21	788978	1.07	0.98
							1.10	1.00

Original data

Result 1

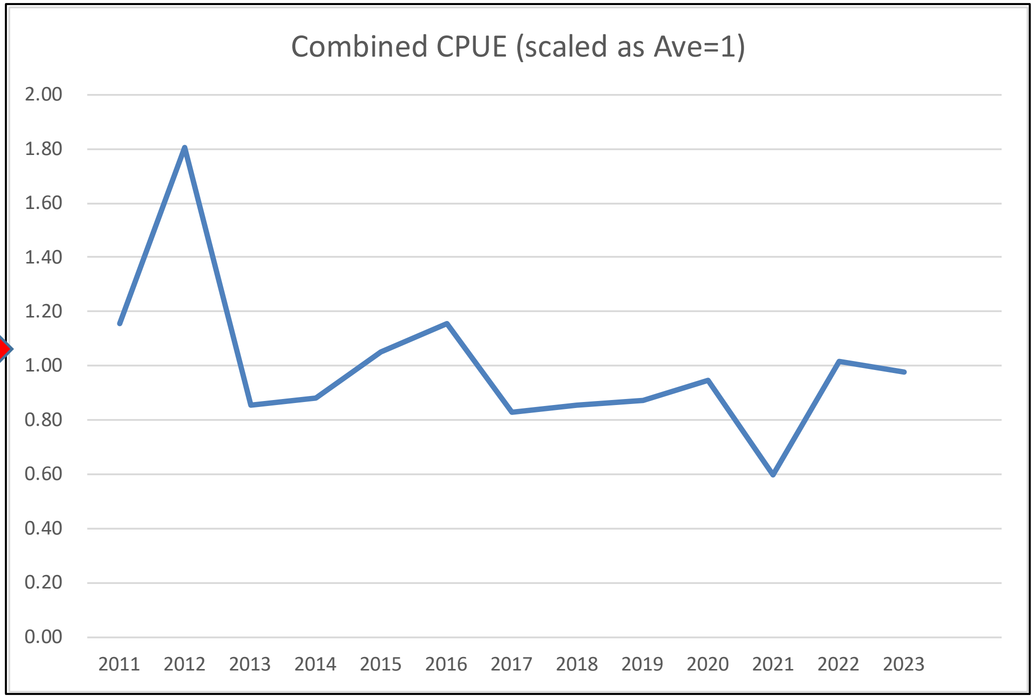
6. [3rd menu] Creating one common standardized CPUE

Results (2nd sheet) Graph for scaled average CPUE (weighted average by catch)



	A	B
1		Scaled CPUE (Ave=1)
2	2011	1.16
3	2012	1.81
4	2013	0.85
5	2014	0.88
6	2015	1.05
7	2016	1.16
8	2017	0.83
9	2018	0.85
10	2019	0.87
11	2020	0.95
12	2021	0.60
13	2022	1.02
14	2023	0.98

2nd sheet
(Default graph)



Users need to edit the default graph to finalize

Appendix A: History of development

Type	Version	Contents	Year/Month
Menu-driven CPUE standardization (specific) software	1.0	Original development (GLM based CPUE standardization)	2016/4
	1.1	Minor improvements of the output (graphics and tables)	2016/6
	1.2		2018/2
	2.0	Additional function (Log-normal GLM & 0 inflated Delta 2 steps log-normal GLM)	2019/5
	2.1	Improvements of the output (graphics and tables)	2021/4
New CPUE_Manager (3 menus)	1.0.0	Original development	2023/8
	1.1.0	Minor improvement	2023/9
	1.2.0	Upgraded New manual (PowerPoint)	2024/1
	1.3.6	4 additional covariates (1 categorical & 3 continuous data) can be used (total 7 Covariates)	2025/3

STOCK ASSESSMENT FOR ALL
MENU-DRIVEN SOFTWARE DEVELOPMENT TEAM