Introduction of the

ICMSF Sampling Plan Tool

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ICMSF Member 2001-present

Introduction

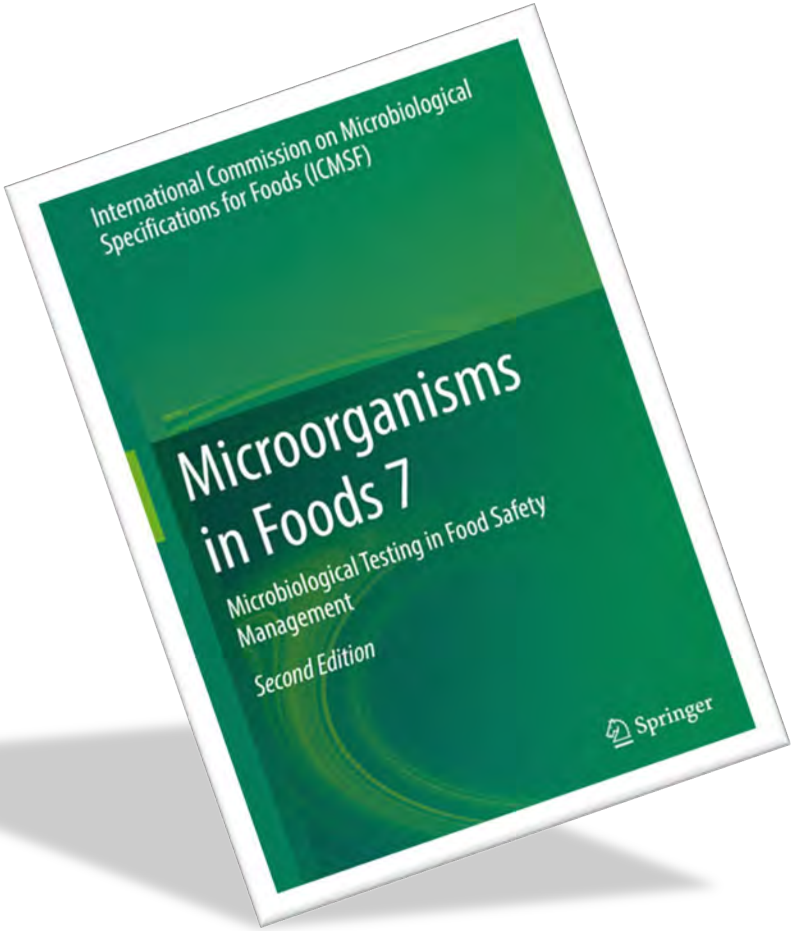
- Purpose of sampling and testing
- The ICMSF Sampling plan tool
- Where to find & download it
- Key design features
- Sampling plan dashboard example

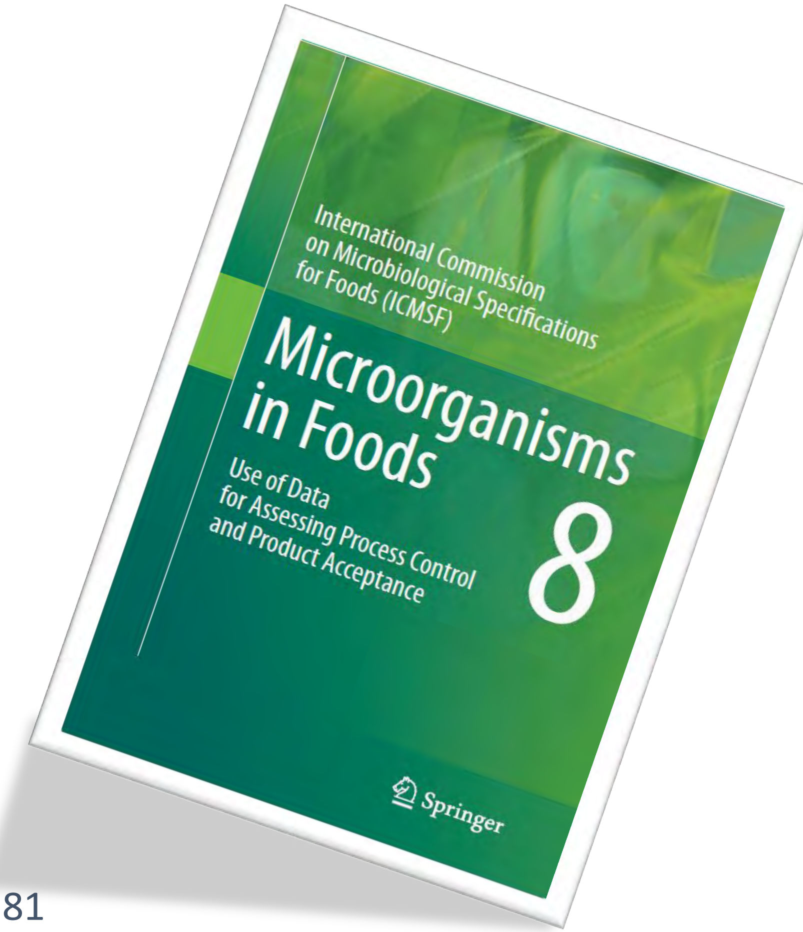
Purpose of sampling and testing

- Microbiological testing is frequently used to verify process control and assess the acceptability of food lots
- Governments may establish acceptability criteria in the form of Microbiological Criteria (MCs) in food safety standards. Industry may use MCs in microbiological specifications for food lots.
- The original ICMSF concept defined 15 Cases of acceptability criteria[1], with specific sampling plans for MCs that are proportional to the necessary stringency of control
- MCs are statistically-based metrics that are often considered complex, challenging to understand and difficult to use

[1] ICMSF, 1986. Microorganisms in Foods 2. Sampling for Microbiological Analysis: Principles and Specific Applications, 2nd ed. University of Toronto Press, Toronto, Canada. ISBN: 0802056938

ICMSF Advice





Book 7: http://www.springer.com/la/book/9783319684581

Book 8: https://link.springer.com/book/10.1007/978-1-4419-9374-8

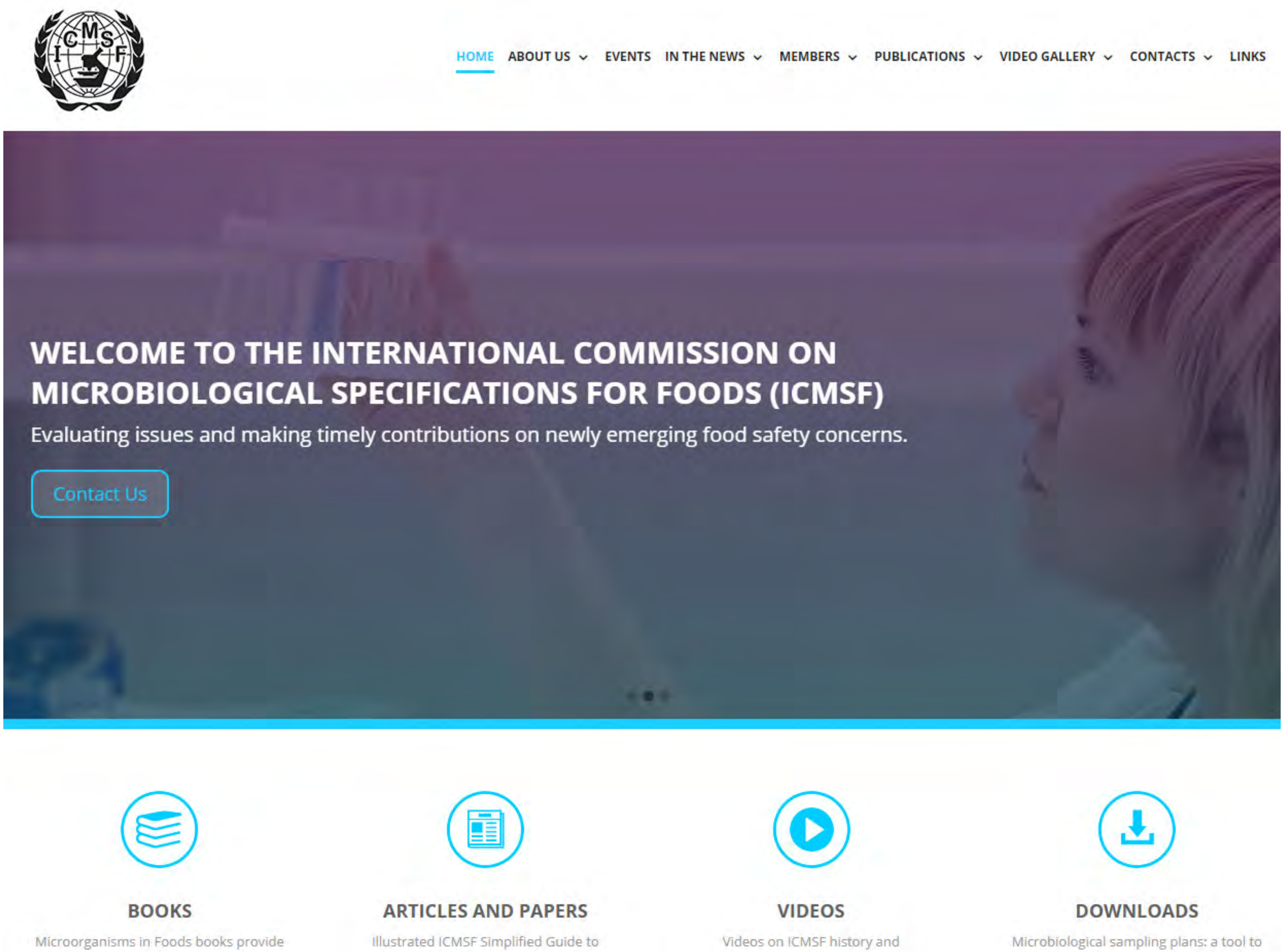
The ICMSF Sampling plan tool

- It is a Windows Excel Spreadsheet posted on ICMSF.org [1]
- The tool covers 2- and 3-class sampling plans that are either qualitative or quantitative
- The tool focuses on functionality and users need to understand the terminology and concepts underlying sampling plans
- It provides support to food professionals and others that, for instance, wish to understand sampling plan performance or design tailored sampling plans
- The tool is updated whenever there are relevant new scientific insights or functionalities. Peer-review is important to us.

[1] https://www.icmsf.org/

www.ICMSF.org

Where to find the tool?



www.ICMSF.org

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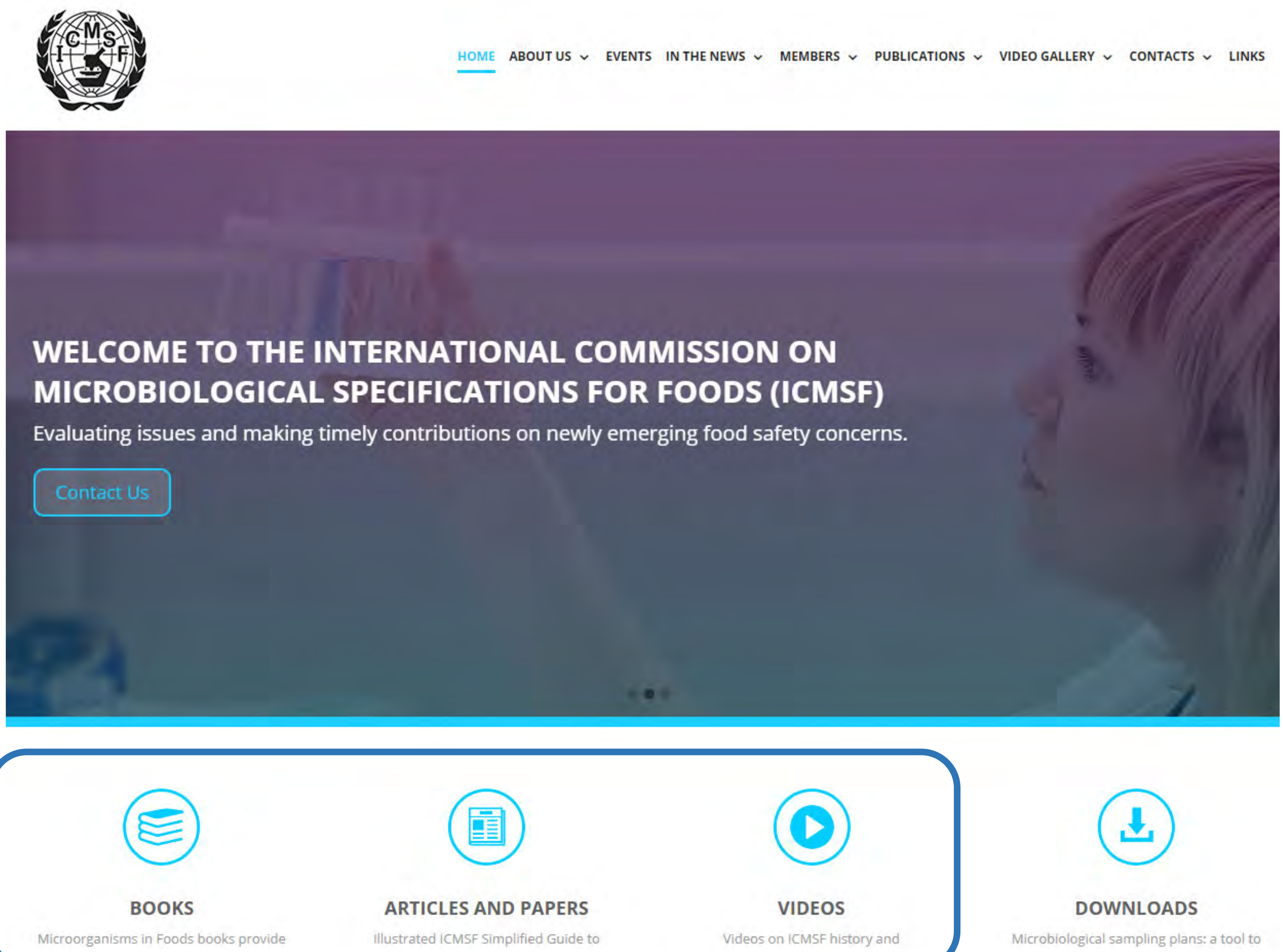

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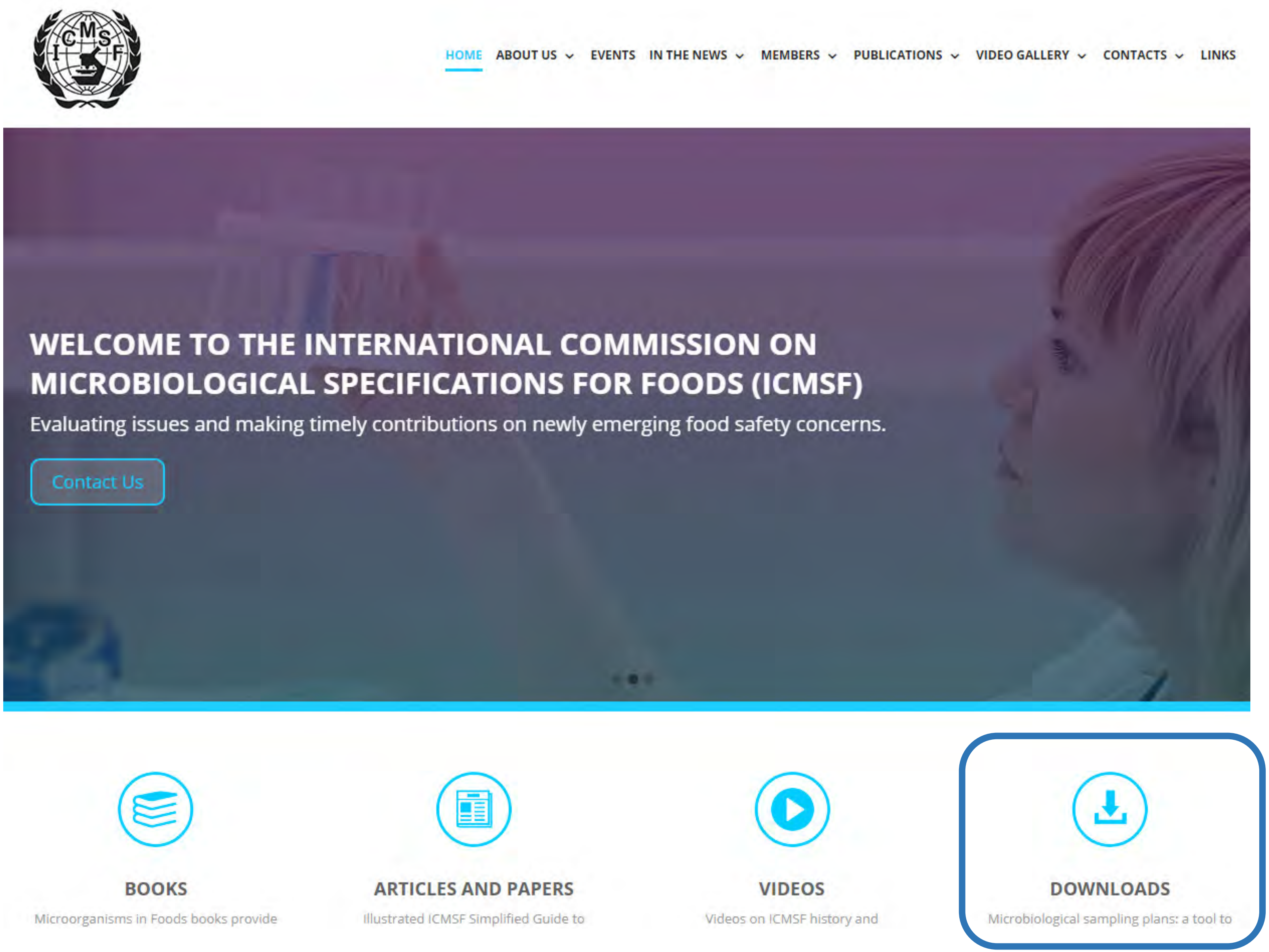

www.ICMSF.org

Where to find the tool?

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SOFTWARE DOWNLOADS

Microbiological sampling plans is a tool to explore ICMSF recommendations.

Standard Program

This spreadsheet calculates probabilities of acceptance for materials with different microbial loads and population standard deviations. The microbes are assumed to be lognormally distributed. This is new version 8 (November 2016) including additionally a tab with the effect of specificity and sensitivity.

Download (Spreadsheet 428 KB)

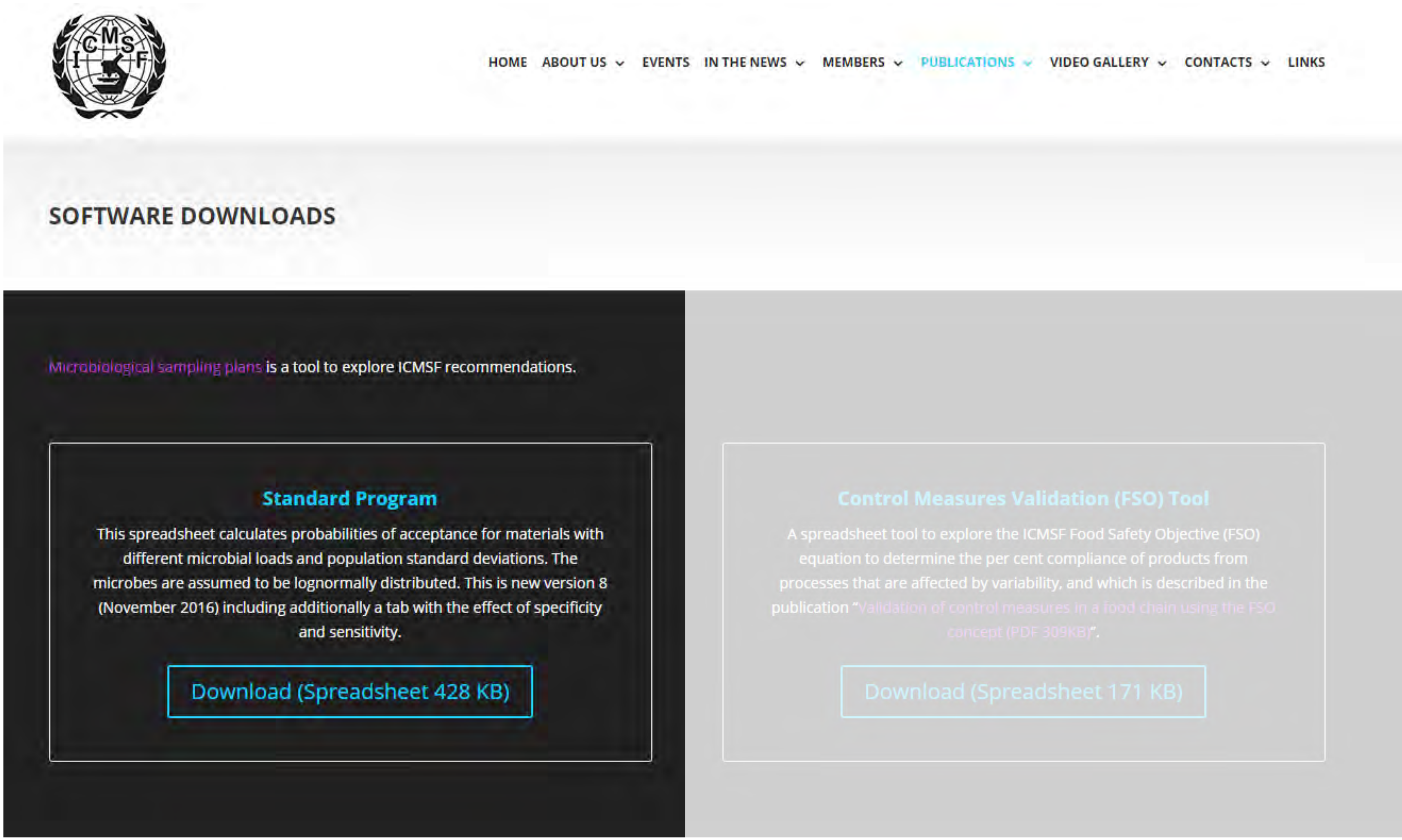
Control Measures Validation (FSO) Tool

A spreadsheet tool to explore the ICMSF Food Safety Objective (FSO) equation to determine the per cent compliance of products from processes that are affected by variability, and which is described in the publication "Validation of control measures in a food chain using the FSO concept (PDF 309KB)".

Download (Spreadsheet 171 KB)

www.ICMSF.org

Where to find the tool?



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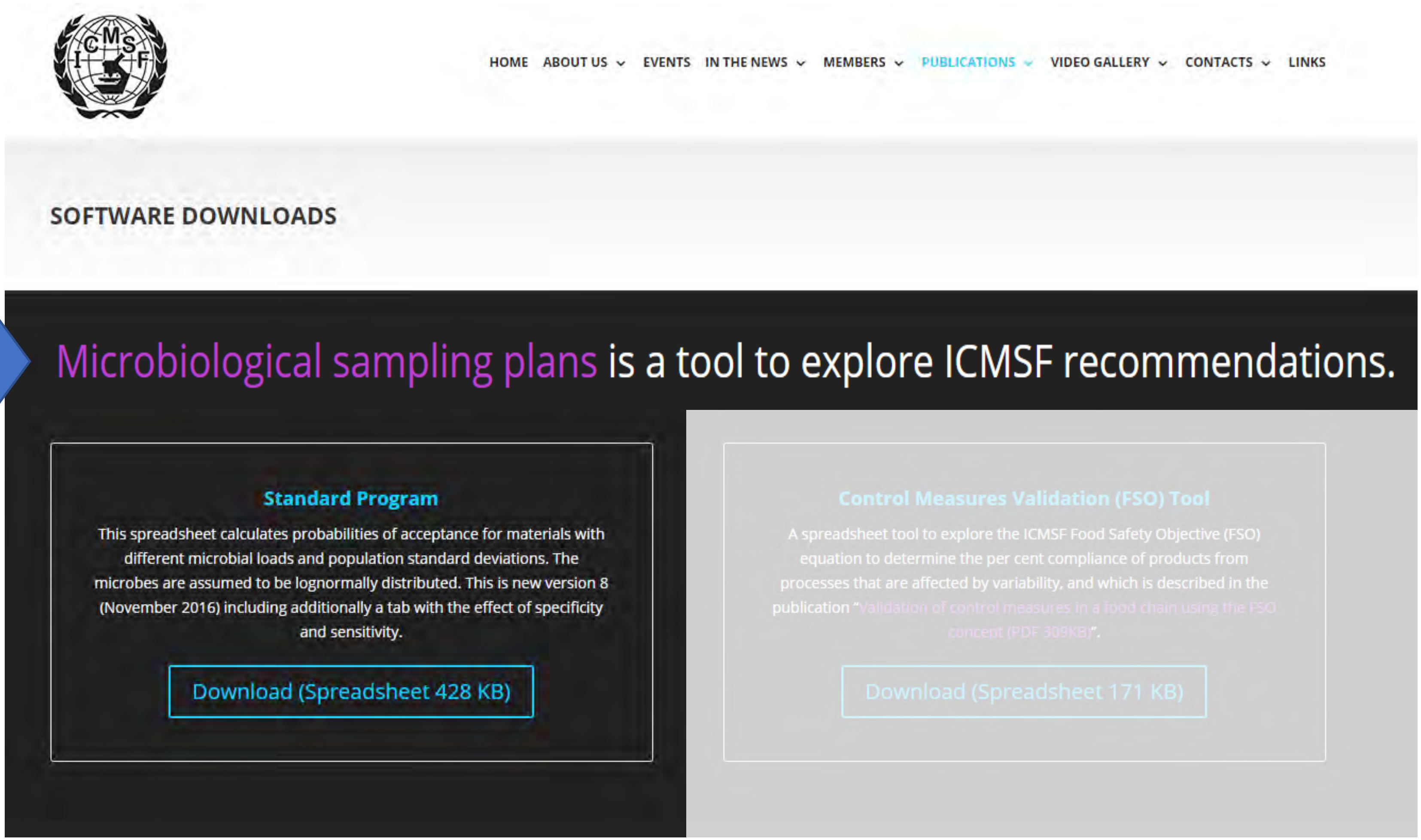


Where to find the tool?

MICROBIOLOGICAL SAMPLING PLANS: A TOOL TO EXPLORE ICMSF RECOMMENDATIONS (SOME EXPLANATION)

TWO-CLASS SAMPLING PLANS (2-CLASS ENRICHMENTS AND 2-CLASS COUNTS)

THREE-CLASS SAMPLING PLANS (3CLASS)

Graphs for three-class sampling plans (from left to right):

Plot 1 – Operating characteristic (OC) surface showing probabilities of accepting a lot depending on two proportions: the proportion defective in the lot exceeding the microbiological limit *M*, named Pd, and the proportion marginally defective between the two microbiological limits *m* and *M*, named Pm.

Acceptance probabilities are calculated for given number of sampling units that are examined, *n*, given microbiological limits *m* and *M*, and given maximum number of sampling units that are allowed to be marginally defective, *c*, i.e. that are allowed to exceed the limit *m* but not *M*. The number of sampling units that are allowed to exceed *M* is assumed to be zero.

Plot 2 – Normal frequency distribution assumed for Log-transformed colony count numbers per gram to be found in sampling units drawn randomly from a lot characterized by given *mean* Log count per gram and given standard deviation *sigma*.

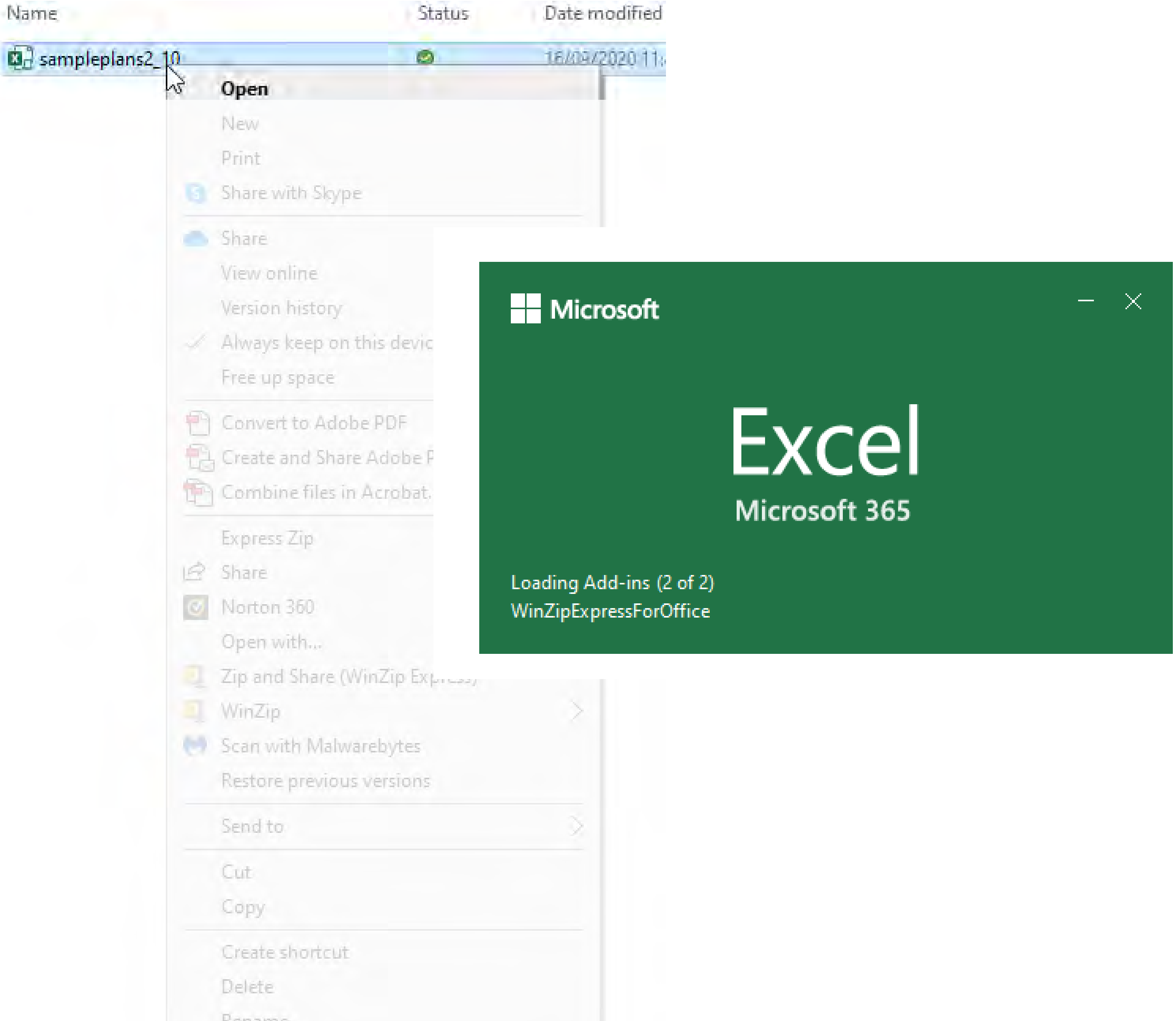
The red vertical line indicates the microbiological limit *M* specified in the sampling plan. Right to *M*the area under the curve corresponds to the proportion defective the lot contains, Pd. The pink vertical line indicates the microbiological limit *m* specified in the sampling plan. The area under the curve between *m* and *M* corresponds to the proportion marginally defective in the lot, Pm.

Plot 3 – Using these proportions defective, these proportions marginally defective, and the given sampling plan specifications for *n* and *c* corresponding probabilities of lot acceptance are calculated. Results are plotted (black) to show the OC curve in relation to Log arithmetic mean counts per gram.

Input fields for two-class sampling plans:

Yellow fields in the center –

- Lot characteristics: *mean* Log count per gram and standard deviation *sigma* shown in Plot 2.
- Sampling plan specifications: the microbiological limits, *m* and *M*, the number of sampling units, *n*, and the number of sampling units that are allowed to be marginally defective, *c*, i.e. that are allowed to exceed the limit *m* but not to exceed *M*.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Status
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sampleplans2_10
Open
New
Print
Share with Skype
Share
View online
Version history
Always keep on this devic
Free up space
Convert to Adobe PDF
Combine files in Acrobat...
Express Zip
Share
Norton 360
Open with...
WinZip
Scan with Malwarebytes
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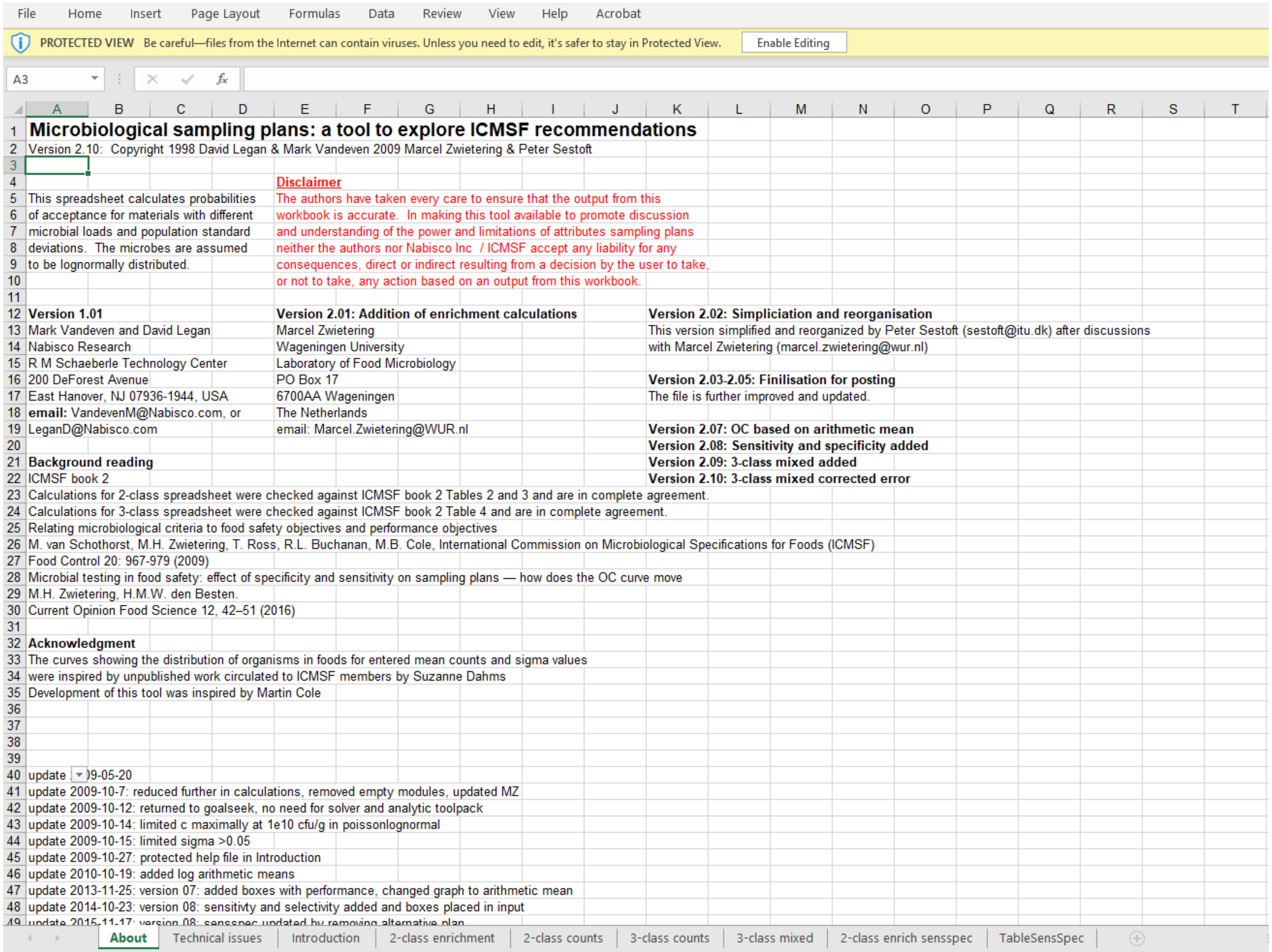
Key design features of the tool



Key design features of the tool

File Home Insert Page Layout Formulas Data Review View Help Acrobat

PROTECTED VIEW Be careful—files from the Internet can contain viruses. Unless you need to edit, it's safer to stay in Protected View. Enable Editing

A3

Microbiological sampling plans: a tool to explore ICMSF recommendations

Version 2.10: Copyright 1998 David Legan & Mark Vandeven 2009 Marcel Zwietering & Peter Sestoft

This spreadsheet calculates probabilities of acceptance for materials with different microbial loads and population standard deviations. The microbes are assumed to be lognormally distributed.

Disclaimer

The authors have taken every care to ensure that the output from this workbook is accurate. In making this tool available to promote discussion and understanding of the power and limitations of attributes sampling plans neither the authors nor Nabisco Inc / ICMSF accept any liability for any consequences, direct or indirect resulting from a decision by the user to take, or not to take, any action based on an output from this workbook.

Version 1.01
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Version 2.01: Addition of enrichment calculations
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Version 2.02: Simpliciation and reorganisation
This version simplified and reorganized by Peter Sestoft (sestoft@itu.dk) after discussions with Marcel Zwietering (marcel.zwietering@wur.nl)

Version 2.03-2.05: Finilisation for posting
The file is further improved and updated.

Version 2.07: OC based on arithmetic mean
Version 2.08: Sensitivity and specificity added
Version 2.09: 3-class mixed added
Version 2.10: 3-class mixed corrected error

Background reading
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Calculations for 2-class spreadsheet were checked against ICMSF book 2 Tables 2 and 3 and are in complete agreement.
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Food Control 20: 967-979 (2009)
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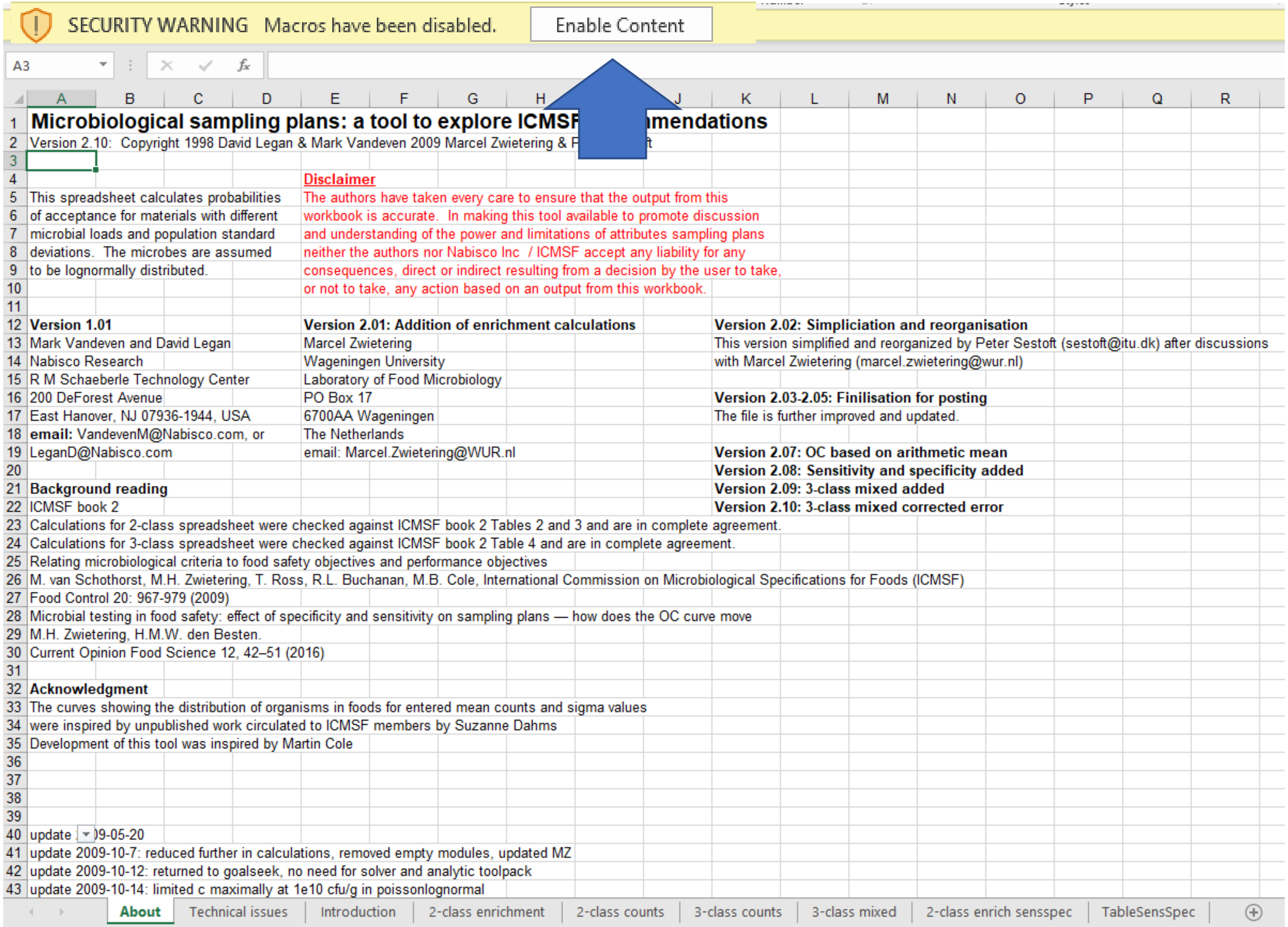
update 2009-10-12: returned to goalseek, no need for solver and analytic toolpack
update 2009-10-14: limited c maximally at 1e10 cfu/g in poissonlognormal
update 2009-10-15: limited sigma >0.05
update 2009-10-27: protected help file in Introduction
update 2010-10-19: added log arithmetic means
update 2013-11-25: version 07: added boxes with performance, changed graph to arithmetic mean
update 2014-10-23: version 08: sensitivty and selectivity added and boxes placed in input
update 2015-11-17: version 08: sensspec updated by removing alternative plan

About | Technical issues | Introduction | 2-class enrichment | 2-class counts | 3-class counts | 3-class mixed | 2-class enrich sensspec | TableSensSpec

Key design features of the tool



SECURITY WARNING Macros have been disabled. Enable Content

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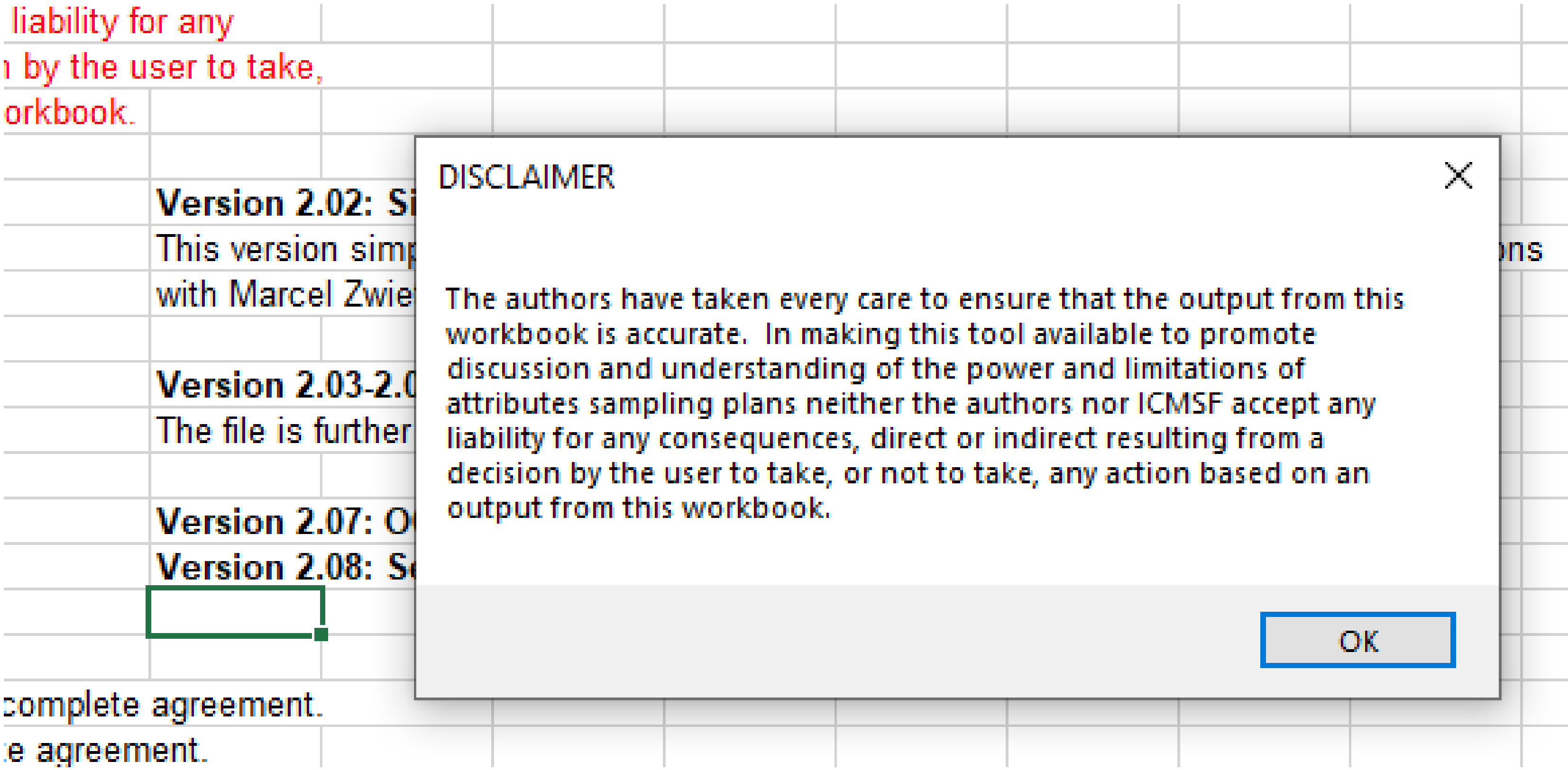

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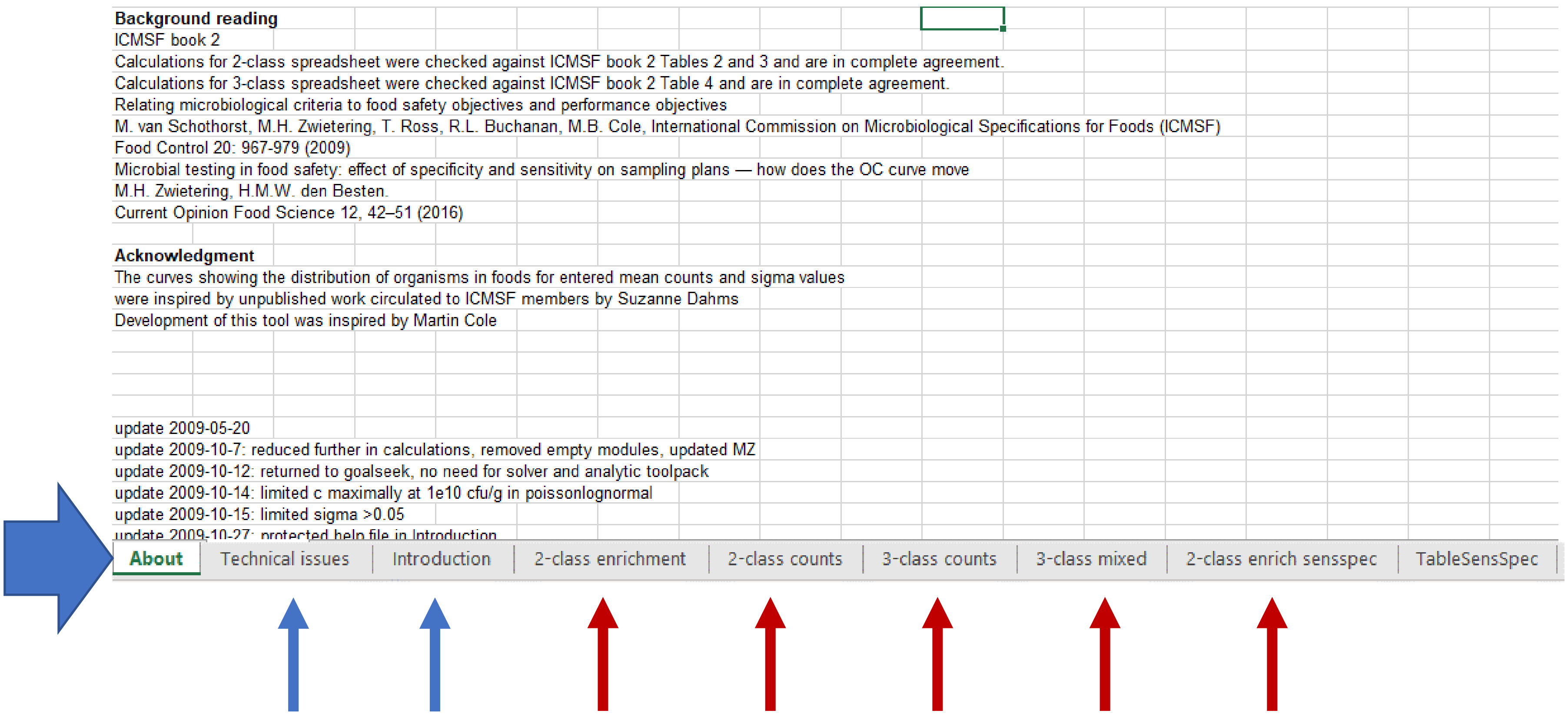

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Help and guidance

Different types of sampling plans

Key design features of the tool

This file can determine the performance of sampling plans for five cases:

• 2-class plans for enrichments (presence/absence, detection of the organism with no count results)	see tab 2-class enrichment
• 2-class plans for quantitative determination (like concentration<100 cfu/g)	see tab 2-class counts
• 3-classplans for quantitative determination (where concentration is compared to both m and M)	see tab 3-class counts
• 3-class mixed plans where m is qualitative and M is a concentration	see tab 3-class mixed
• 2-class plans for enrichments including effects sensitivity and specificity	see tab 2-class enrich sensspec
• Effects of sensitivity and specificity (fixed values) are also presented in a tabular form	see tab TableSensSpec

Description of the used variables

Data entry cells are highlighted in yellow: All other cells are protected.

mean	mean of the (assumed) log normal distribution describing the occurrence of bacterial contaminants; unit is log cfu per gram
sigma	standard deviation of the same (assumed) log normal distribution
m	acceptable level of microbiological contamination, defined as an allowable concentration, or for enrichement no contamination in a sample of a certain weight, hence equals minus log(weight)
n	number of samples tested
c	number of samples whose contamination is allowed to exceed m (that is, test positive for contamination), yet the lot will be accepted
amount	sample weight, in gram (only relevant for 2-class enrichement plans)
P(accept)	the probability of accepting a specific lot; this is a function of the assumed contamination level (mean, sigma) and the sampling plan (n, c and amount). This is usually set at 5%, this then means there is 5% probability of acceptance, or 95% probability of detecting such unacceptable lot
sensitivity	true positive rate= TP/(TP+FN), (assumed to be fixed value depending on the method and not dependant on the concentration of the organisms)
specificity	true negative rate= TN/(TN+FP), (assumed to be fixed value depending on the method and not dependant on the concentration of the organisms)

The Implied Acceptance Level, shown on all 'tabs' (worksheets), allows you to calculate the proportion of all the samples in the lot that would be expected to be above any chosen logCFU value (i.e., a user input). For that logCFU, the z-score is also calculated.

For a manual please open the following word-file

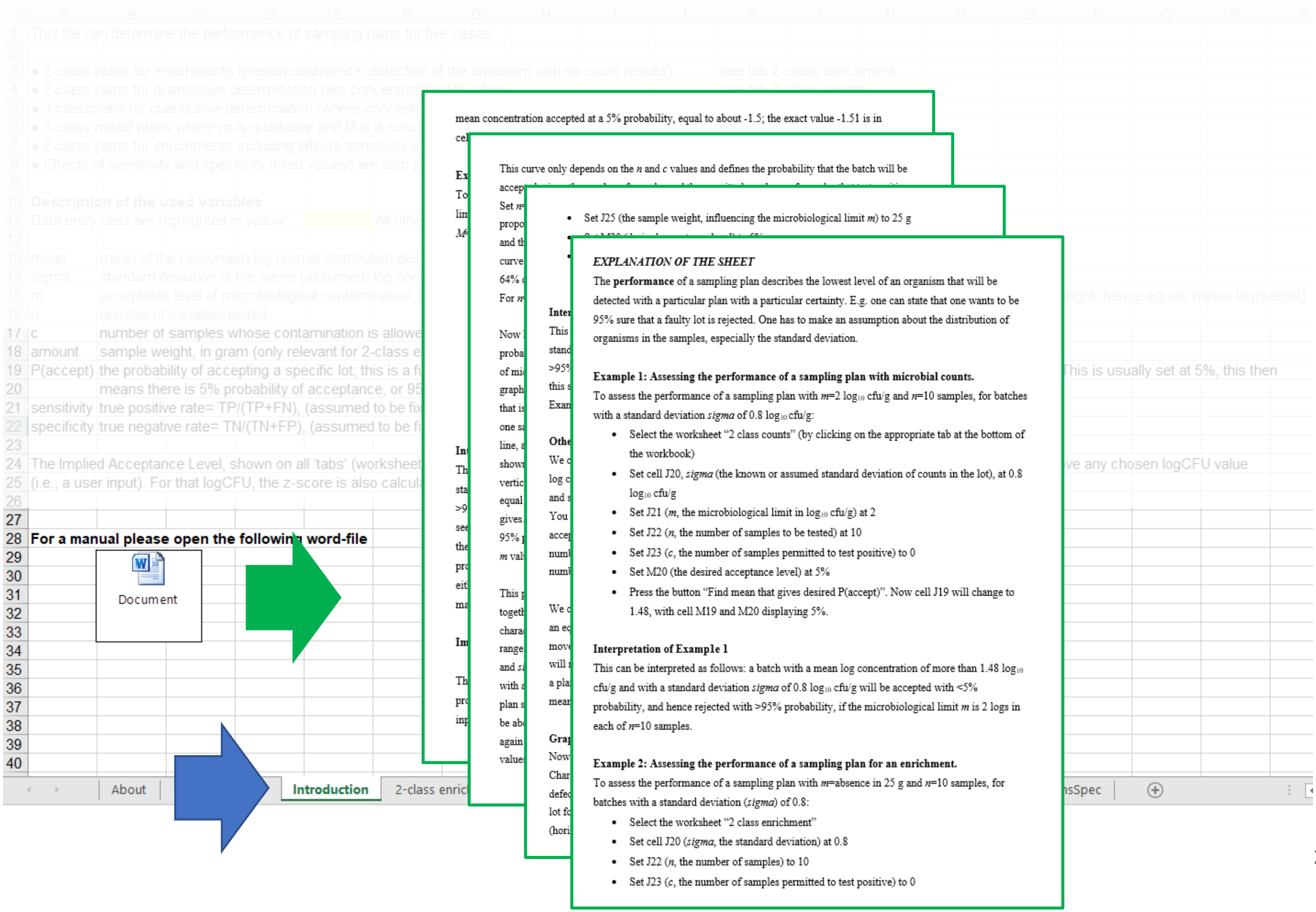
Document

For an explanation on arithmetic and geometric means open the following word-file

Document

About | Introduction | 2-class enrichment | 2-class counts | 3-class counts | 3-class mixed | 2-class enrich sensspec | TableSensSpec

Key design features of the tool



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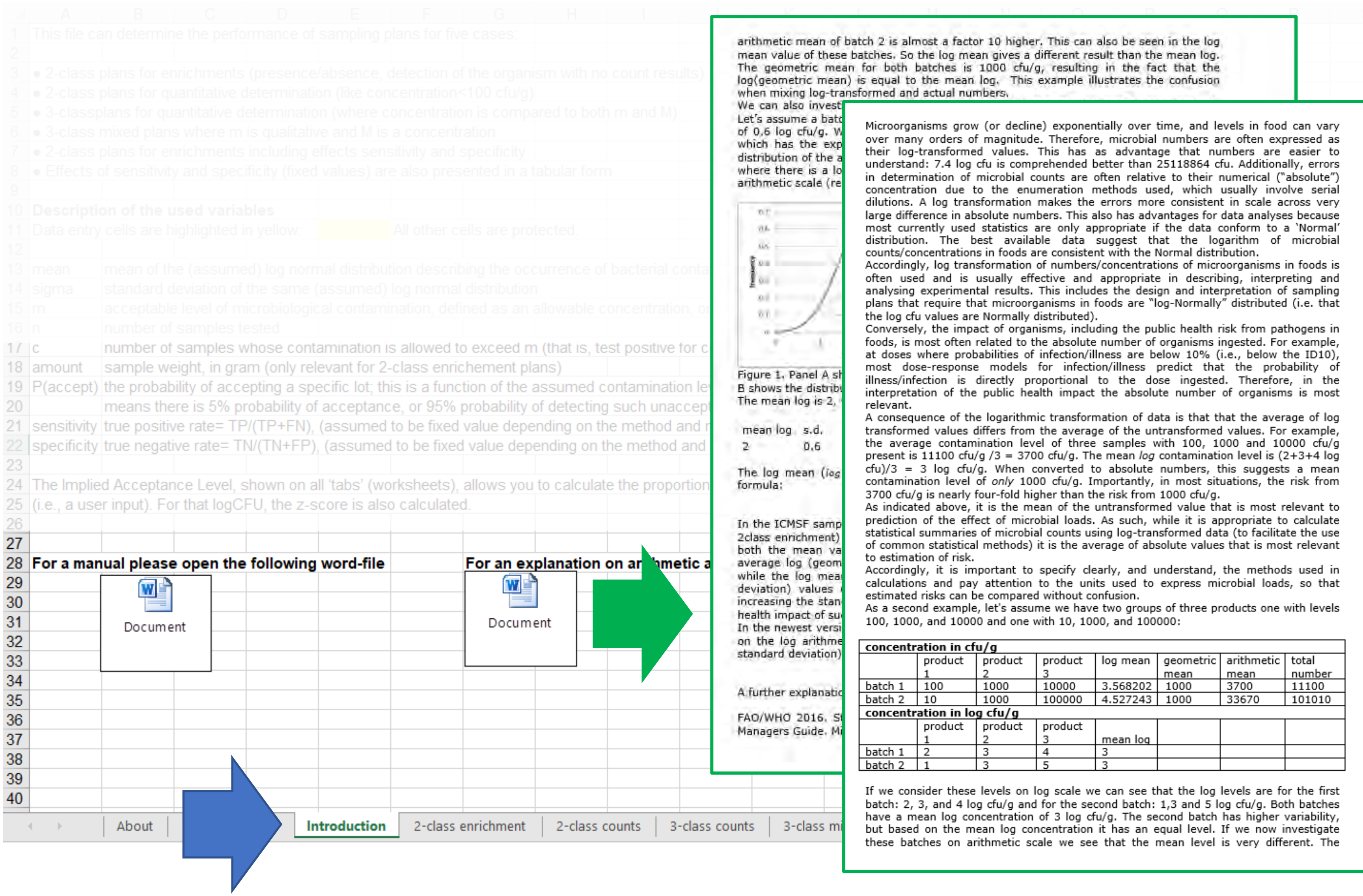
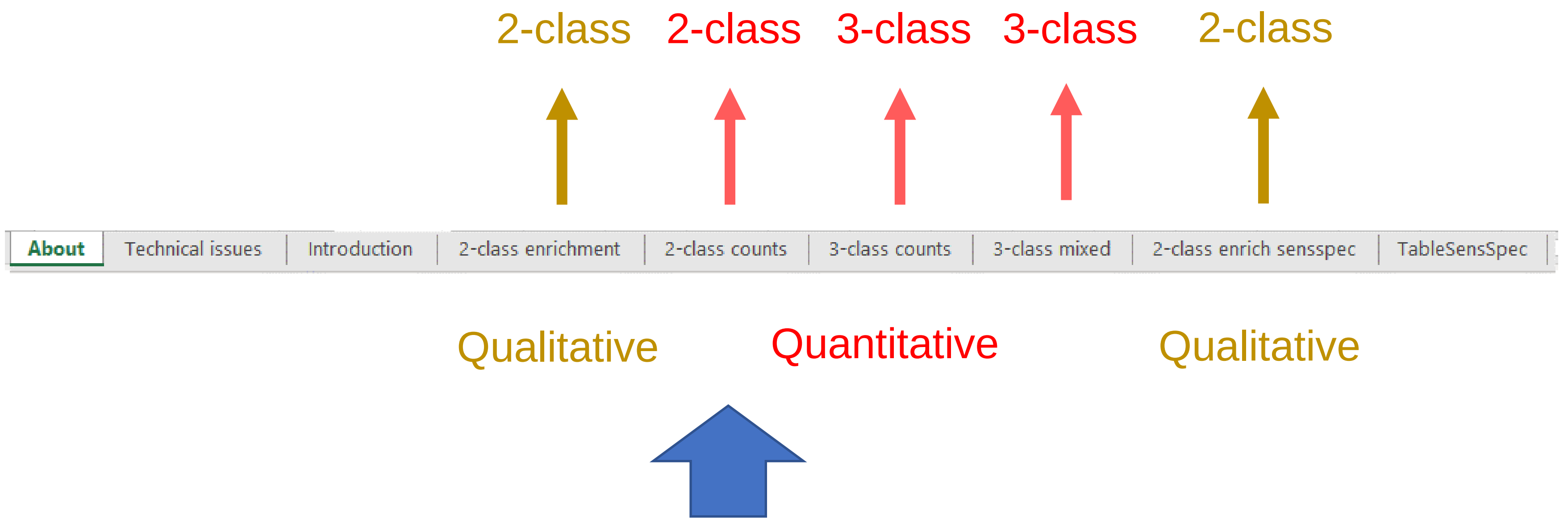
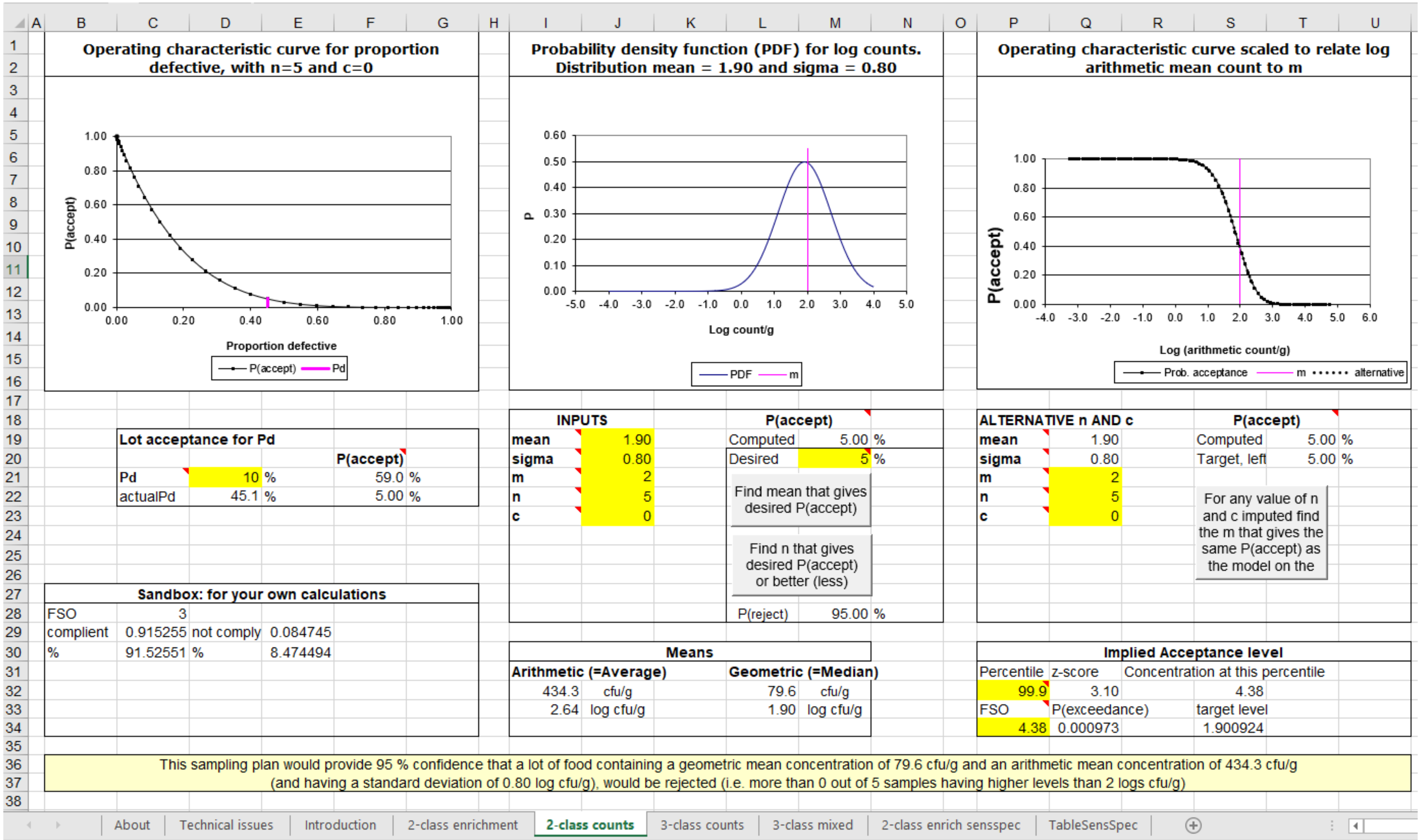


Key design features of the tool

Types of sampling plans



Example sampling plan dashboard



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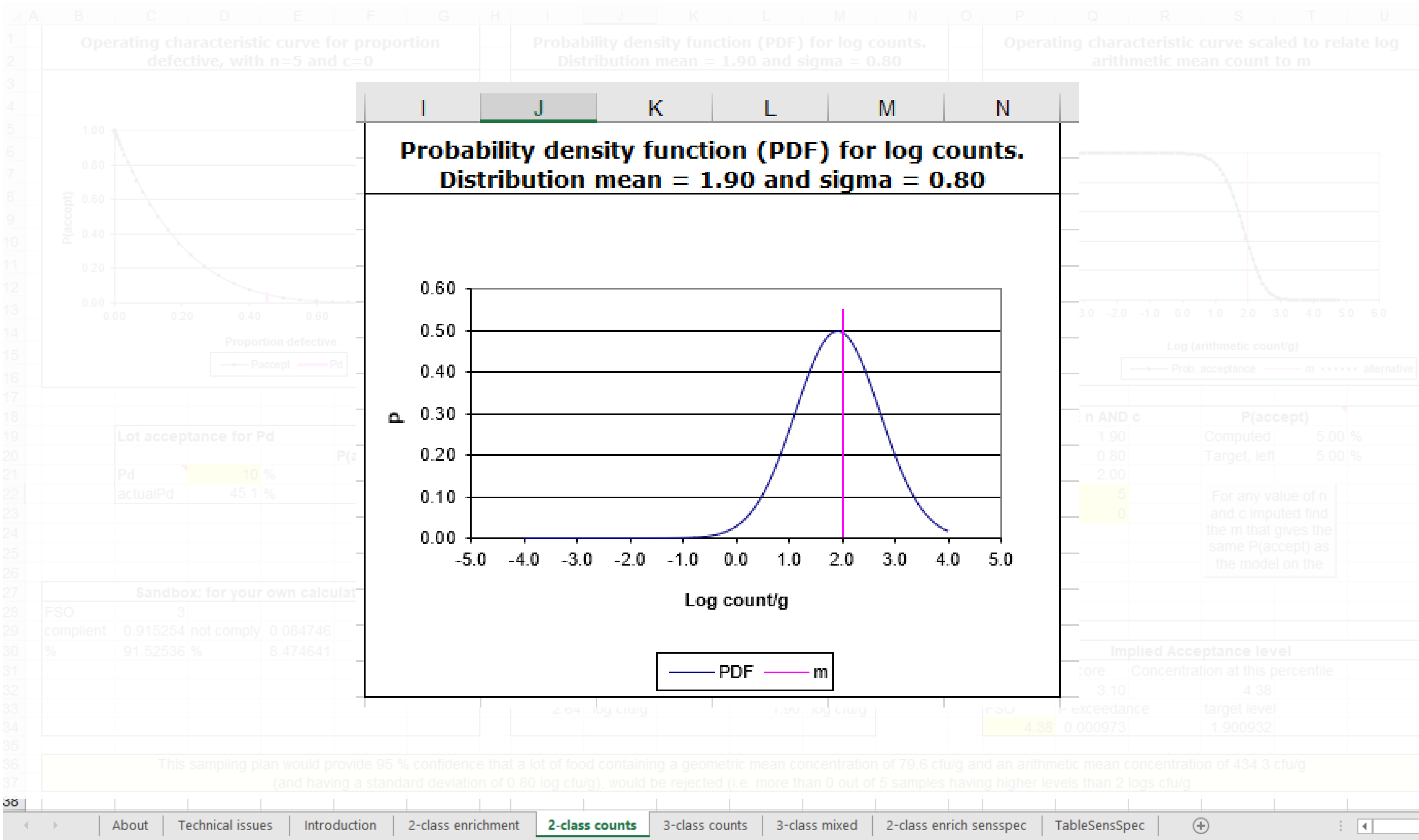

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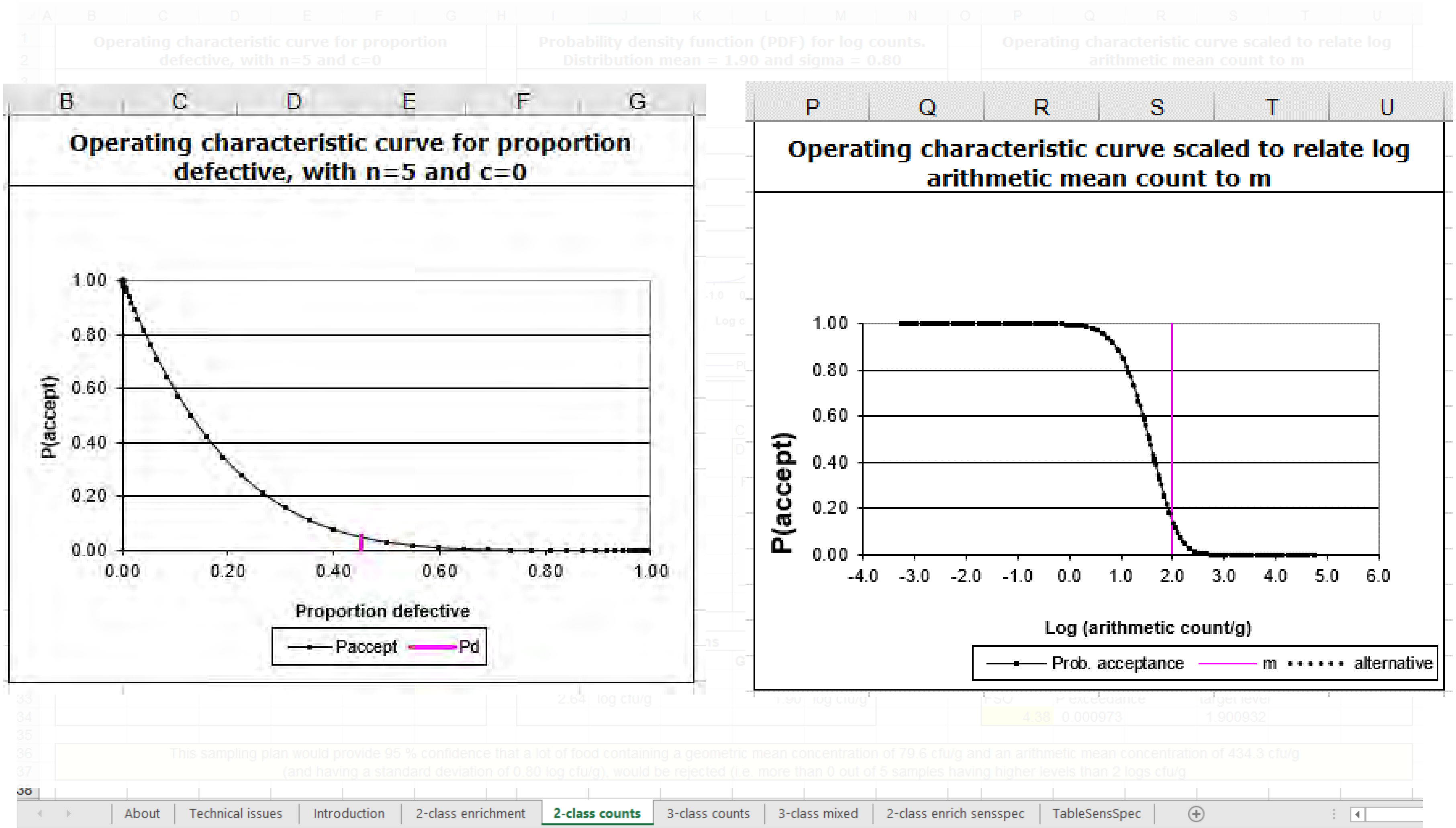

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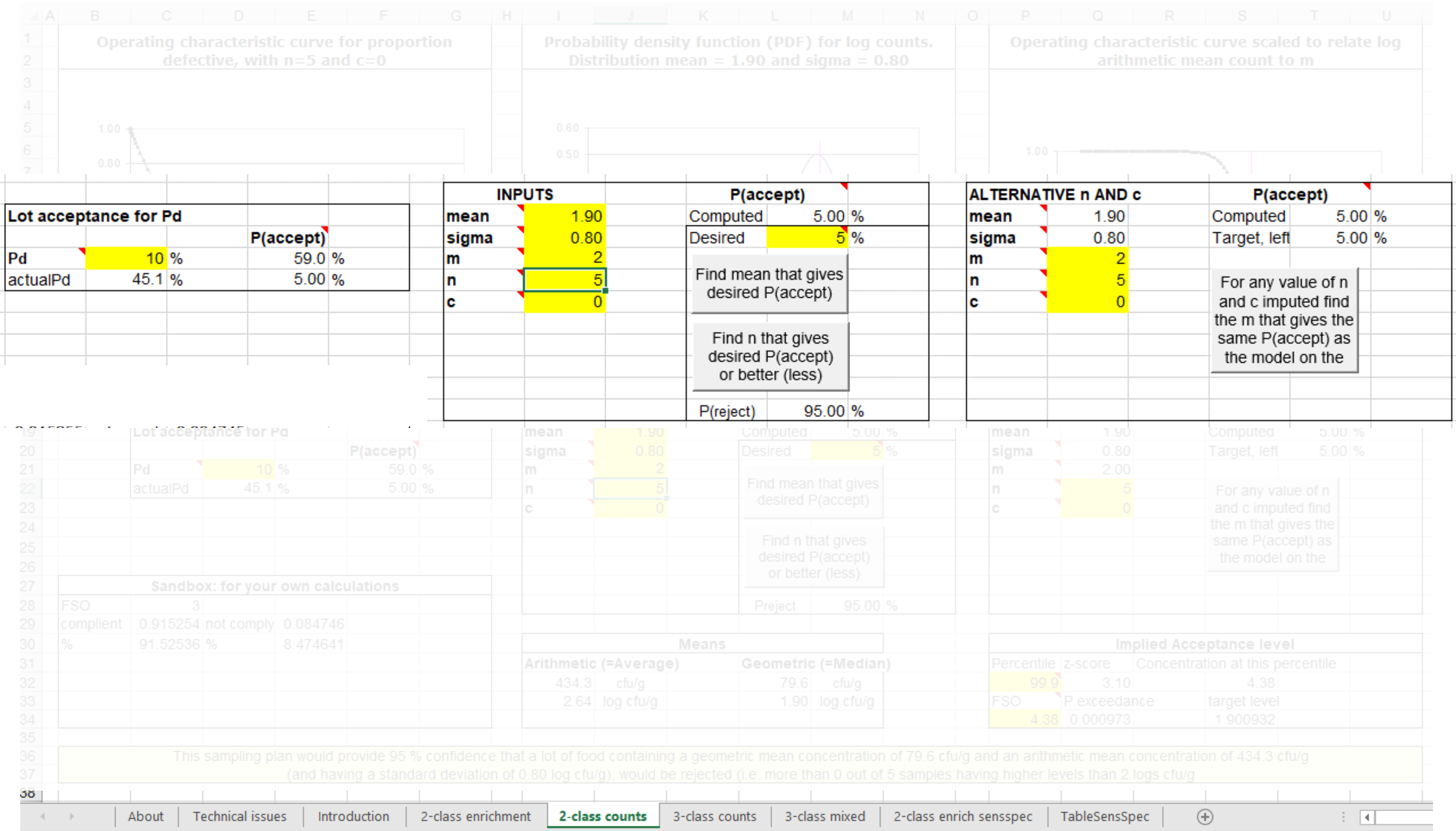

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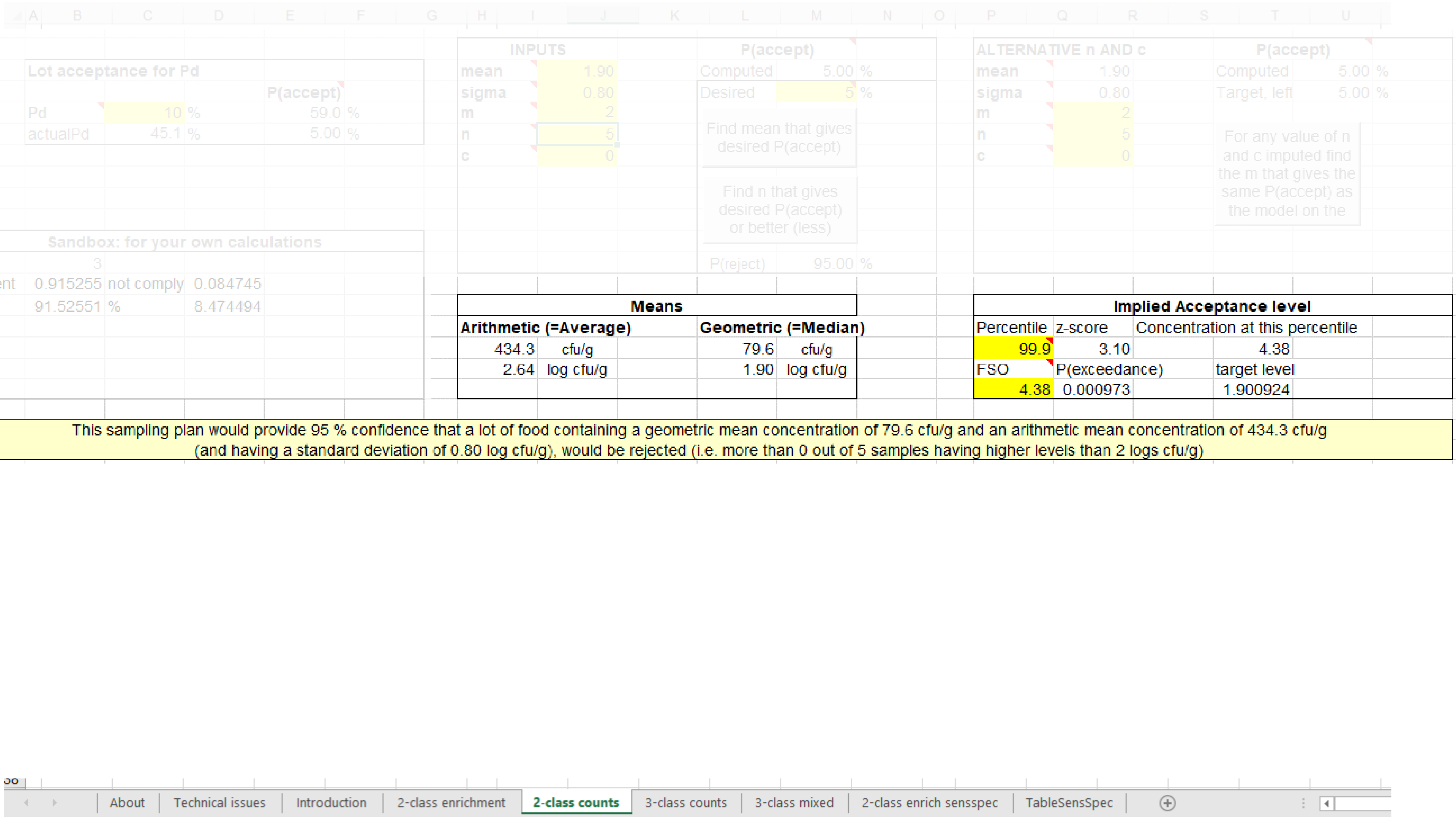
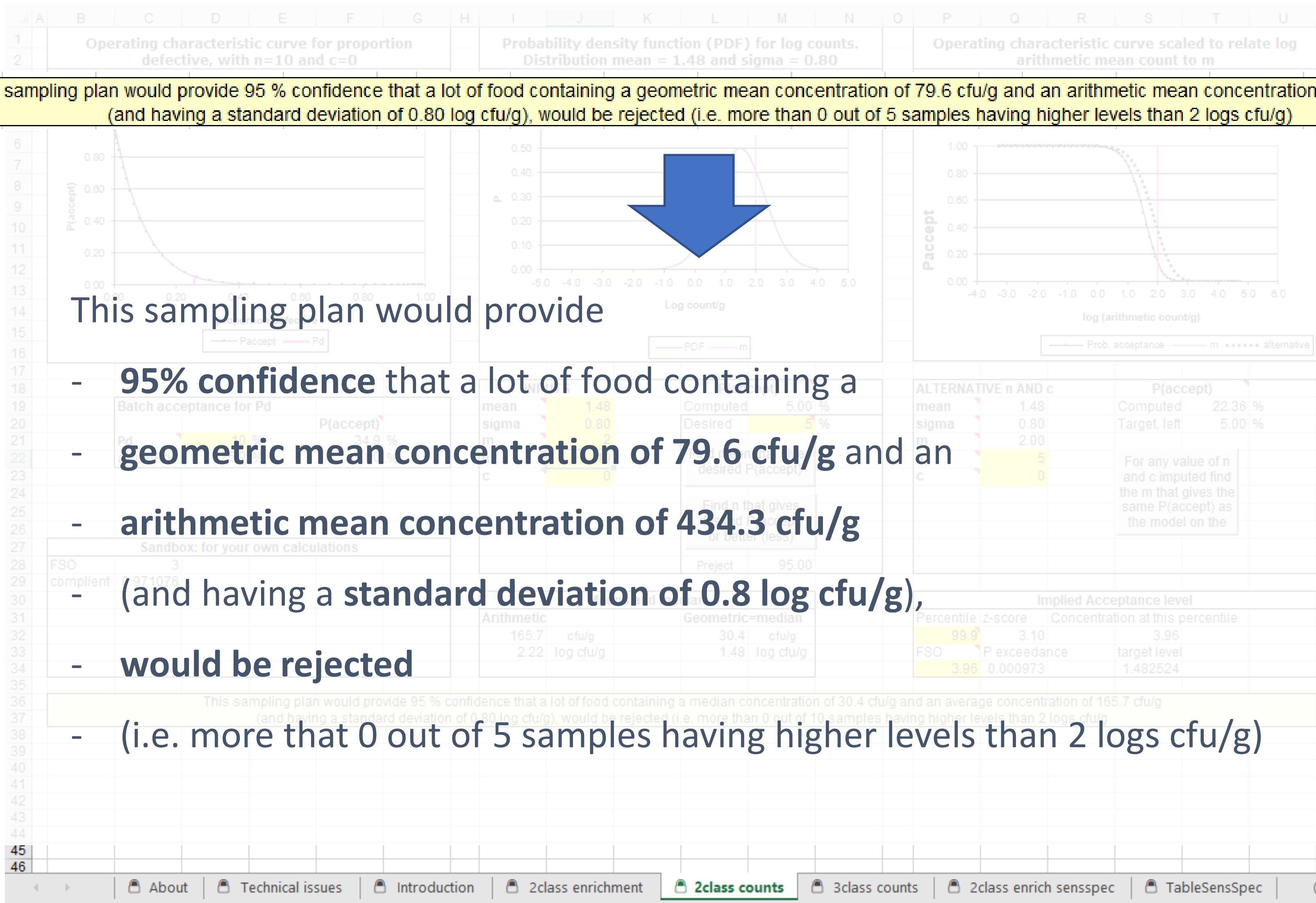


Example sampling plan dashboard

This sampling plan would provide 95 % confidence that a lot of food containing a geometric mean concentration of 79.6 cfu/g and an arithmetic mean concentration of 434.3 cfu/g (and having a standard deviation of 0.80 log cfu/g), would be rejected (i.e. more than 0 out of 5 samples having higher levels than 2 logs cfu/g)



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- **95% confidence** that a lot of food containing a
- **geometric mean concentration of 79.6 cfu/g** and an
- **arithmetic mean concentration of 434.3 cfu/g**
- (and having a **standard deviation of 0.8 log cfu/g**),
- **would be rejected**
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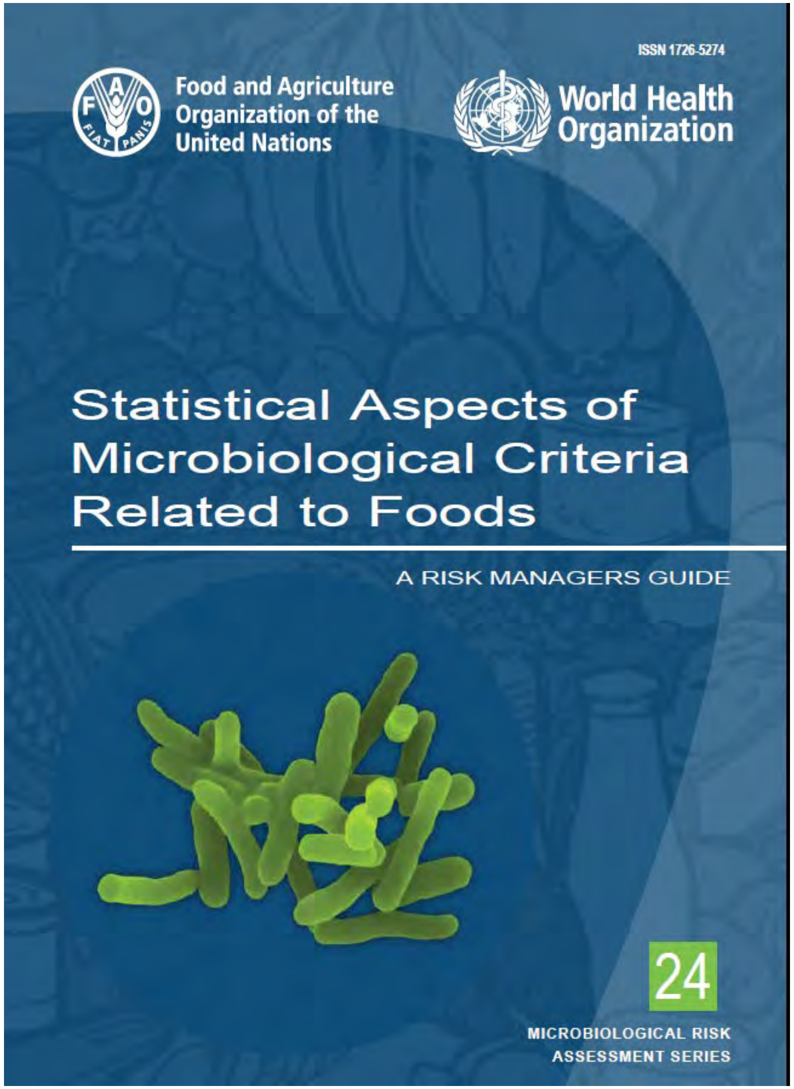
JEMRA Sampling plan resources



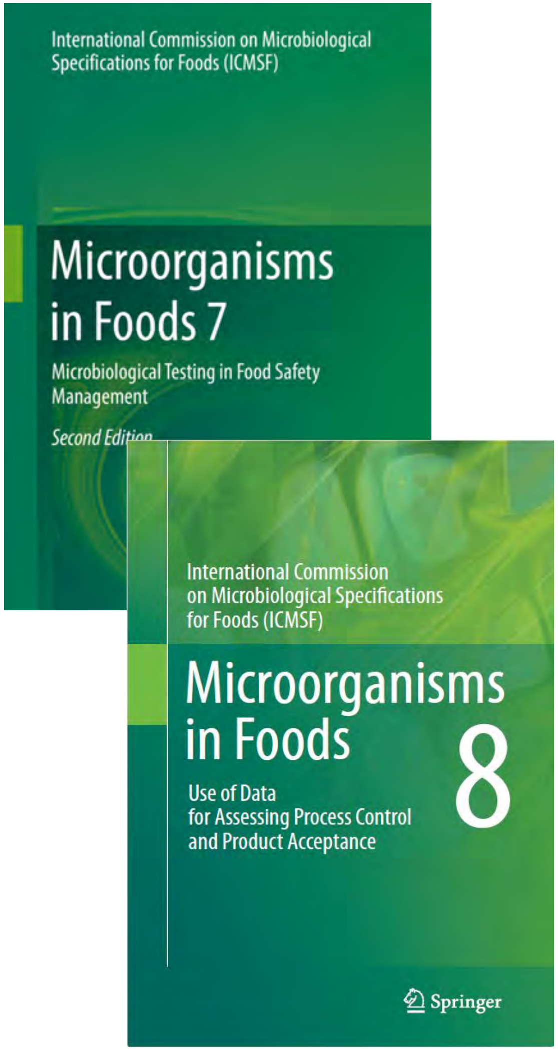
https://www.who.int/foodsafety/publications/mra_24/en/

Microbiological Criteria and Sampling Plan analysis tool

A Microsoft Excel version can be downloaded from: http://fao.org/2/jABhk and http://www.who.int/foodsafety/publications/mc-tool.xlsx

Full playlist available at https://www.youtube.com/playlist?list=PLzp5NgJ2-dK5pegu_aA0r0lTUfjM8Z7El

Summary



- The ICMSF Sampling plan tool has been created to support users to interpret and establish Microbiological Criteria and sampling plans
- More information in Books 7 and 8
- Other video-clips in the ICMSF playlist present further context to the tool as well as details of its utility and functioning

For more information, see www.icmsf.org