# Step-by-step instructions

# For using the sample size calculator









## Step-by-step Instructions for Using the Sample Size Calculator

The North American Plant Protection Organization - NAPPO - has developed different tools to facilitate the implementation of Risk-Based Sampling (RBS). Among them is a sample size calculator that can be found on the NAPPO website at <a href="https://www.nappo.org/index.php">https://www.nappo.org/index.php</a>. In order to access this and all other RBS tools click on "more information" in the Risk-Based Sampling section of the home page (Figure 1).



Figure 1. NAPPO home page and how to access the Risk-Based Sampling (RBS) tools.

The sample size calculator was specifically designed for a Risk Management and Risk-Based Sampling Workshop jointly organized by USDA/APHIS and the Inter-American Institute for Cooperation in Agriculture (IICA) in Lima, Perú in September of 2018. The workshop was hosted by the General Secretariat of the Andean Community (CAN).

The tool helps us calculate the appropriate sample size for inspection but also assists users in the organization of data derived from inspection activities at ports, airports and border points.







HOME ABOUT DIRECTORY GOVERNANCE DOCUMENTS

CALENDAR PEST ALERTS CONTACT

Click to Access International Symposium for RBS Files

# RESOURCES AND LEARNING TOOLS FOR RISK-BASED SAMPLING

This page brings together resources, tools, training materials and exercises to assist in the development and implementation of a risk-based sampling program. You can access the resources by clicking directly in the graphic shown to the right or by using the hyperlinks that follow in the text below.

Two of the resources – the **Proceedings** and the **RBS Manual Part I** – are deliverables from the first ever International Symposium for Risk-Based Sampling held in Baltimore, MD, USA in mid-2017. You can access the event report for the International Symposium here.

Included in the RBS Manual Part I you will find the **Hypergeometric Tables** (you can also find them as Appendix 2 - page 111) that can assist you in determining the appropriate sample size for inspection based on the lot size, the maximum acceptable infestation level you wish to detect and the desired confidence level that you feel comfortable with. The Hypergeometric Tables can also help you determine the percentage of infestation that would be detected at various confidence levels with various sample sizes.

Another way to determine the sample size is using the **Sample Size Calculator**. This tool can be downloaded and used to organize data derived from inspections conducted at ports, airports, and border points. In addition, the formulae embedded in the calculator can be used to estimate sample sizes based on Risk-Based Sampling concepts. The Sample Size Calculator was designed for use in a workshop on Best Practices for Risk Management and Risk-Based Sampling held in Peru in 2018.

The RBS Manual Part I also includes a **Practical Exercise** (you can also find it as Appendix 3 - page 144) that helps you compare the results when conducting inspections using percentage-based versus Risk-Based Sampling.



#### Navigation Instructions

Use your mouse to place the pointer on the link of interest and click to access the information.



Figure 2. Details on finding/accessing the sample size calculator.

At the bottom of the page is the link to the sample size calculator in Excel format. Download it by clicking <u>XLSX</u> (Figure 3). Once you download the Excel file to your PC, you can begin using the tool which includes the following workbooks:





- Sample size calculator
- Database for inspection data
- How to randomize the samples
- Directory of importers
- Directory of exporters
- Directory of producers

NAPPPO Noth American Plant Pla	n Organization le Protección a las Plantas	HOME ABOUT	DIRECTORY	GOVERNANCE	DOCUMENTS CALEN	DAR PESTALERTS	CONTACT	
Learning Tools					Home / English / Lear / Resources and Lear Based Sampling / Sample Size Calcula	ming Tools for Risk-		
GO BACK								
SAMPLE SIZ	E CALCULATOR							
Sampling held in Lima, Pe	DL was designed by Maribel Hurtado, Bob Griffir ru in late September, 2018. The event was spor APPO. The workshop was hosted by the Genera	nsored by the Interamerican	Institute for Coo	peration in Agric			l,	
The tool can be used to org Sampling concepts.	anize data derived from inspections conducted	at ports, airports and border	points. The forn	nulae can be use	d to estimate sample sizes	s based on Risk-Based		
FORMAT	DEVELOPERS							
xLSX frag	Maribel Hurtado, Bob Griffin and	Steve Hong						

Figure 3. Where to download the sample size calculator tool.

Below we describe each workbook and its use:

• **Cover page:** the cover page has links to each of the workbooks (Figure 4).



This Excel Spreadsheet tool was designed by Manbel Hurtado, Bob Griffin and Steve Hong for use in a recent workshop on Best Practices for Risk Management and Risk-Based Sampling held in Lima, Peru in late September 2018. The event was sponsored by the Interamerican Institute for Cooperation in Agriculture - IICA, cooperatively delivered by IICA, USDA-APHIS-PPQ and NAPPO. The workshop was hosted by the General Secretariant of the Andean Community – CAN.

Figure 4. Cover page for the sample size calculator.





### Sample size calculator:

This workbook is used to calculate the number of samples that an inspector should inspect from a commercial consignment or lot given the following parameters – level of detection or level of risk acceptance, level of confidence, lot size and sample unit. The workbook will calculate the sample size if the parameters are entered in the appropriate workbook cells. The formula used to calculate the sample size (n) is based on hypergeometric probability (Fosgate, 2009).

$$n = \left(1 - (\alpha)^{1/D}\right) \left(N - \frac{D-1}{2}\right)$$

Where,

**D** is the level of detection, **1**- $(\alpha)$  is the level of confidence and **N** is the lot size.

- ✓ Level of detection/acceptance (D): is the minimum infestation percentage or proportion detected at a specified level of confidence established by the National Plant Protection Organization (NPPO). For illustration purposes we will use 10%.
- ✓ **Confidence level (1-α):** indicates the probability that a consignment with a particular level of infestation is detected. A 95% confidence level is routinely used; it should be entered as 0.95 in the workbook.
- ✓ Lot size (N): the total number of units in the consignment.
- ✓ Sampling Unit: the unit chosen for sampling, for example box, individual fruit, individual bouquet, etc.

Sample síze calculator									
Hypergeometric distribution									
Detection level Risk acceptance level	10%	The detection leve size, register the data methodology will NPPO set to detect confidence level, lot							
Confidence level (1-a)	0,95	The confidence le size and sampling unit, bility that a consignment with a degree of infestation exceeds the detection level to be detected. A 95% confidence level is usually applied.							
Lot size (N)	100	Total number of units in the lot.							
Sampling unit	Вох	The units of a lot which will be sampled (e.g., box, bag, plant, etc.)							
Sample size (n)	25	The sample size is the number of sample units selected from the lot or consignment to be inspected or subject to testing.							
Go to presentation Go to database for inspec Go to randomized sample		Go to directory of importers Go to directory of exporters Go to directory of producers							
Presentation Sample size Database fo	r inspection data	Randomized samples Directory of importers Directory of exporters 🕂 : 4							

Figure 5. Sample size workbook.



R ISK-B	A SETD S	ALADE IN	C R BS

In our example using a level of detection of 10%, a confidence level of 95% and a lot size of 1,000 boxes, the resulting sample size is 29 boxes.

## Database for inspection data:

Use the workbook table to collect/organize data gathered during inspections at ports, airports, and border points (Figure 6).

	Databa:	se for insp	ectíon data									
1	Go to Sample size			Go to directory o	to directory of importers to directory of exporters to directory of producers							
Consignment ID	Certificate Number	Date (dd/mm/yyyy)	Import/Export	Lot Size_N	Sample unit	Sample size_ n	Randomized samples	Country of origin	Country of destination	Commodity	Consignme	
► Prese	entation Sample size	Database for	inspection data	Randomized s	amples Dir	ectory of importers	Directory of ex	porters 🕂	:			

Figure 6. Table to collect/organize inspection data.

Additional details on data for this workbook.

- Consignment number or ID: enter the consignment unique identification number.
- Certificate number: enter the phytosanitary certificate number.
- Date (dd/mm/yyyy): enter the consignment shipment date.
- Import/Export: indicate if consignment is being imported or exported.
- Lot size N: enter the consignment lot size.
- Sampling unit: enter the unit chosen for sampling (box, fruit, etc.)
- Sample size: enter the calculated sample size or the number of units that were sampled or tested.
- Randomization of samples: indicate whether samples were randomized or not.
- Country of origin: for imports indicate country of origin.
- Country of destination: for exports indicate country of destination.
- Product: common name of the product.
- Consignment: For each consignment select "1".
- Scientific name of the product: indicate scientific name of the product.



- Product category: indicate category for example: fruit, vegetable, seed, plant for planting, flower, etc.
- Product type: for example, fresh fruit, processed fruit, vegetable seed, tree seed, ornamental seed, wild plants for planting, in vitro plants for planting, etc.
- Additional product information: to note additional product information that could be relevant.
- Importer: provide importer unique identification number.
- Exporter: provide exporter unique identification number.
- Producer: provide producer unique identification number.
- Pest common name: if a pest is found during inspection record its common name. Note each pest should have an individual data entry.
- Pest scientific name: if a pest is found during inspection record its scientific name.
- Pest type: indicate the type of pest that was intercepted; for example, insect, mite, nematode, weed, mollusk, etc.
- Pest stage: indicate the developmental stage of the pest; for example, egg, nymph, adult, etc.
- Number of pests: indicate the total number of a specific pest found in the consignment.
- Pest categorization: is the pest a quarantine pest, a non-quarantine pest or a regulated non-quarantine pest (consult ISPM 5).
- Pest risk level: indicate whether pest risk is high, medium, low or no risk.
- Action: if the consignment will require mitigation of the intercepted pest enter 1; otherwise enter zero "0".
- Name of inspector performing the inspection.
- General observations: if appropriate note additional observations concerning the consignment.

#### How to randomize the samples

This workbook assists in the selection of samples to inspect. The data for lot size and sample size come from the sample size workbook. In the example the lot size is 1,000 and the sample size is 29; according to the workbook, the appropriate randomized simples should include boxes 642, 839, etc., as seen in Figure 7.





#### Randomízed samples

Lot size	100	# of sampling units to be
Sample size	25	inspected
1		72
2		79
3		36
4		63
5		15
6		3
7		64
8		17
9		70
10		16
11		47
12		51
13		37
14		77
15		18
16		16
17		9
18		6
19		87
20		68
21		67
22		24
23		1
24		16
25		89
26		49
27		58
28 29		60 30

**Figure 7**. Randomizing the samples taking into account lot size and sample size calculated using in the Sample Size workbook.

#### Directory of importers

Prese

In this workbook we collect pertinent data on the importers including the registration code or number of the importing company or the importer assigned by the NPPO, the name or registered name of the importing company, the unique identification number of the importing company, the complete address, the GPS coordinates, the importer's name, telephone, email and a space for general comments (Figure 8).





#### Directory of importers

 Go to presentation
 Go to database for inspection data

 Go to Sample size
 Go to directory of exporters

 Go to randomized samples
 Go to directory of producers

Registration code or number of the importing company/import er with the NPPO		NIT/ Identification of the importing company	Address of the importing company	Geographic coordinates	Name of the importer	Telephone of the importer	e mail	General comments
Presentation	on Sample size Databa	ase for inspection data	Randomized samples	irectory of importer	Directory of exporte	rs Directory of pro	ducers 🕘	1

Figure 8. Directory of importers.

#### Directory of exporters

In this workbook we collect pertinent data on the exporters including the registration code or number of the exporting company or the exporter assigned by the NPPO, the name or registered name of the exporting company, the unique identification number of the exporting company, the complete address, the GPS coordinates, the exporter's name, telephone, email and a space for general comments (Figure 9).

	Directory of exporters									
	Go to presentation       Go to directory of importers         Go to Sample size       Go to database for inspection data         Go to randomized samples       Go to directory of producers									
Registration code or number of the exporting company/export er with the NPPO		NIT/ Identification of the exporting company	Address of the exporting company	Geographic coordinates	Name of the exporter	Telephone	E-mail	General comments		
Presentation	Sample size Database for inspe	ction data Randomized	samples Directory of importers Directory	y of exporters Directo	ry of producers	(+)	4			

Figure 9. Directory of exporters.



### Directory of producers

In this workbook we collect relevant data on the producers including the registration code or number for the field/farm or the producer assigned by the NPPO, the name or registered name of the field/farm, the complete address, the GPS coordinates, species of fruits and vegetables being produced in the field/farm, area (in ha) that is planted per species, estimated monthly production by commodity, producers name, telephone, email and a space for general comments (Figure 10).

	Directory of producers											
		₿	Ir a Presentación     Go to sample size     Go to randomized samples		Go to director Go to databas Go to director	e for inspection dat	a					
Registration code or number of the field/producer with the NPPO	Name or registered name of the field	Address of the farm	Geographic coordinates	Species of registered fruits or vegetables	Registered area per species	Estimated monthly production by species	Name of the producer	Telephone	E-mail	General comments		
Presentation	on Sample size Databi	ase for inspection data	Randomized samples Directory	of importers Dire	ectory of exporters	Directory of produ	cers (+)	1				

Figure 10. Directory of producers.

Using these tools to calculate the sample size and organize inspection data facilitates the conduct of simple statistical analyses that can guide/inform future sampling approaches and lead us to adopt more precise, strategic, and effective sampling schemes that take into account the appropriate level of protection given the risk of introduction of each pest. An additional benefit is it allows us to optimize the use of resources dedicated to inspection.