

Histamine Sampling Tool User Guide

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Overview

This tool provides support to the user in two main areas related to sampling for histamine:

- Designing a Sampling Plan
 - Use this tool to explore options for numbers of samples and concentration thresholds given a defined histamine concentration limit
- Analyzing the performance of a Sampling Plan

Use this tool to analyze a specific sampling plan's ability to detect acceptable or non-conforming lots of product

From the main screen of the tool the user can select which of the abovementioned calculations to undertake by selecting either “Design a Plan” or “Analyze a Plan”. The user can also access supporting documentation from the main screen.

This document provides step-by-step guidance on the use of the tool to either design or analyze a sampling plan for histamine

Design a Plan

What the tool does

This tool will attempt to find sampling plans which meet user-defined objectives.

The tool will search for combinations of the number of samples, n , and a concentration threshold, m , that achieve these objectives.

Using the tool

The User needs to specify the values for all the parameters described below in order for the tool to find possible sampling plans.

Parameters

Default values are provided for the different parameters listed below. The user can modify these default values to match their requirements. In some cases the user may consider the default value appropriate and retain it. The user can then click on "Compute Results" to view the designed plans.

Each parameter must be within the range defined in the tool. Values outside of this range will not be accepted by the tool and the user will not be able to proceed.

Parameter	Value	Allowable Range
Histamine Limit (H) (mg/kg):	<input type="text" value="200"/>	(10 to 500)
Level of Protection:	1 in <input type="text" value="1000"/>	(100 to 10000)
Confidence Limit (%):	<input type="text" value="98"/>	(90 to 99)
<hr/>		
Standard Deviation (log₁₀):	<input type="text" value="0.5"/>	(0.1 to 2.0)
Acceptable number of samples above little m (c):	<input type="text" value="0"/>	(0 to 5)
Maximum samples (n_{max}) to test:	<input type="text" value="10"/>	(3 to 50)
<input type="button" value="Compute Results"/>		

Definition of Parameters

Histamine Limit

This is a user-defined maximum acceptable concentration of histamine, often a health-based and/or regulatory limit (e.g. 200 mg/kg).

Level of Protection

This is the maximum acceptable fraction of samples from a lot allowed to exceed the histamine concentration limit (H), e.g. 1 in 10,000 samples.

Confidence Limit

This is the desired confidence limit that lots that do not meet the level of protection specified will be rejected by the sampling plan.

Standard Deviation

This is the expected standard deviation of the histamine concentration within a lot. It is on the \log_{10} scale. When combined with a \log_{10} mg/kg mean concentration value, it is used to generate a log-normal distribution of histamine concentration within the lot.

m

"Little m" is the criterion against which test units comprising the sample will be assessed for compliance, expressed in mg/kg.

Acceptable number of samples above little m (c)

The plan design will include a parameter which defines a concentration threshold, m, generally referred to as "little m". Sample concentrations higher than little m are counted and compared to this value, c. If the count exceeds c then the lot is rejected.

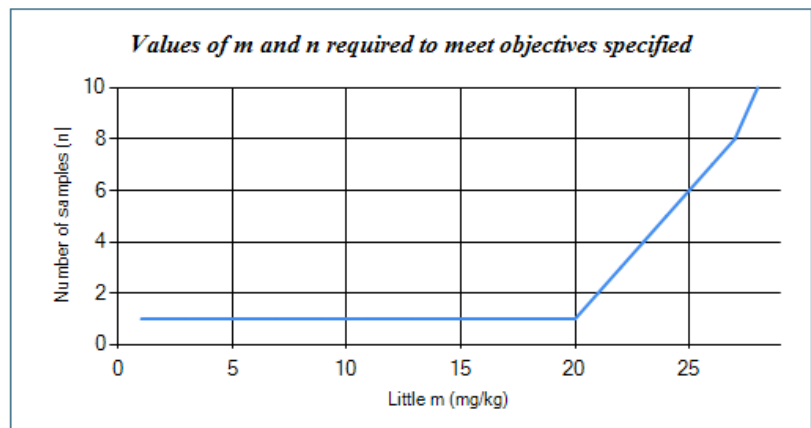
Maximum samples (n_{\max}) to test

The tool will consider plans where the number of samples, n, does not exceed n_{\max} . This is the maximum number of samples which the user is willing or able to test and so sampling plans with sample numbers higher than this will not be proposed.

Results

The tool provides a table and chart showing the minimum required number of samples to be tested (n) at different concentration thresholds (little m) to achieve the objectives specified by the user. For example, the parameters defined in the screen shot above indicate that the user wants to be 98% confident that the histamine limit of 200mg/kg will not be exceeded by more once in every 1000 samples. In order to achieve this the user wants to test no more than 10 samples, does not want any sample to exceed little m and expect that the standard deviation of histamine levels in the products being tested is 0.5 \log_{10} mg/kg.

Number of samples (n)	m (mg/kg)
1	1
2	21
3	22
4	23
5	24
6	25
7	26
8	27
10	28



Thus, given these parameters or user requirements, 2 samples would need to be taken and analyzed if little m was 21 mg/kg and 10 samples would be needed if little m was 28 mg/kg. In the table, values for n are only shown when the value for m changes. For example, the value of m must change from 1 mg/kg to 21 mg/kg before a second sample is required. However, after that point, increasing m marginally also increases the number of samples required.

The results generated here depend on the standard deviation assumed above. The user should rerun the analysis from this tool against other standard deviations by adjusting the value above or using the **Analyze a Plan** tool described below, to gain insights into the impact of the standard deviation on the proposed sampling plans. This may be particularly relevant if there is a lot of uncertainty with regard to the variability of histamine levels in the products being tested.

Analyze a Plan

What the tool does

This tool estimates the probability of accepting lots of product given that they are tested according to a user-defined sampling plan.

Using the tool

The User needs to specify the values for all the parameters described below in order for the tool to analyze the performance of a specific user defined sampling plan.

Parameters

Default values are provided for the different parameters listed below. The user can modify these default values to match their requirements and click "Compute Results" to view the sampling plan's performance.

Each parameter must be within the range defined in the tool. Values outside of this range will not be accepted by the tool and the user will not be able to proceed.

Parameter	Value	Allowable Range
Number of samples (n):	<input type="text" value="3"/>	(1 to 100)
Little m (mg/kg):	<input type="text" value="50"/>	(1 to 200)
Acceptable number of samples above little m (c):	<input type="text" value="0"/>	(0 to 5)

Optional: a second concentration parameter, Big M, is included for three-class sampling plans. If a single sample has a concentration higher than Big M, the lot is rejected.

Concentration Threshold for Unacceptability (M) (mg/kg):	<input type="text" value="200"/>	(10 to 500)
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Histamine Limit (H) (mg/kg):	<input type="text" value="200"/>	(10 to 500)
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Standard Deviation (\log_{10}):	<input type="text" value="0.5"/>	(0.1 to 2.0)
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[Compute Results](#)

Definition of Parameters

Number of samples (n)

n is the number of samples to be tested per lot.

Little m

“Little m” is the criterion against which test units comprising the sample will be assessed for compliance, expressed in mg/kg. Sample concentrations higher than little m are counted and compared to c, below. If the count exceeds c then the lot is rejected.

Acceptable number of samples above little m (c):

This is the acceptable number of samples allowed above little m before the lot is rejected. A value of 0 indicates the lot will be rejected if any samples are found above little m. Note, if Big M is included, a

single sample above Big M will result in the lot being rejected regardless of the value of c and c should be greater than 0.

Concentration Threshold m for Unacceptability (M)

This is an optional a second concentration parameter, referred to as “Big M”, which needs to be defined in the case of a three-class sampling plans. If a single sample has a concentration higher than Big M, the lot is rejected.

The user should indicate if the plan includes Big M or not using the dropdown list provided:

Include Big M:

Histamine Limit

This is a user-defined maximum acceptable concentration, often a health-based and/or regulatory limit.

Standard Deviation

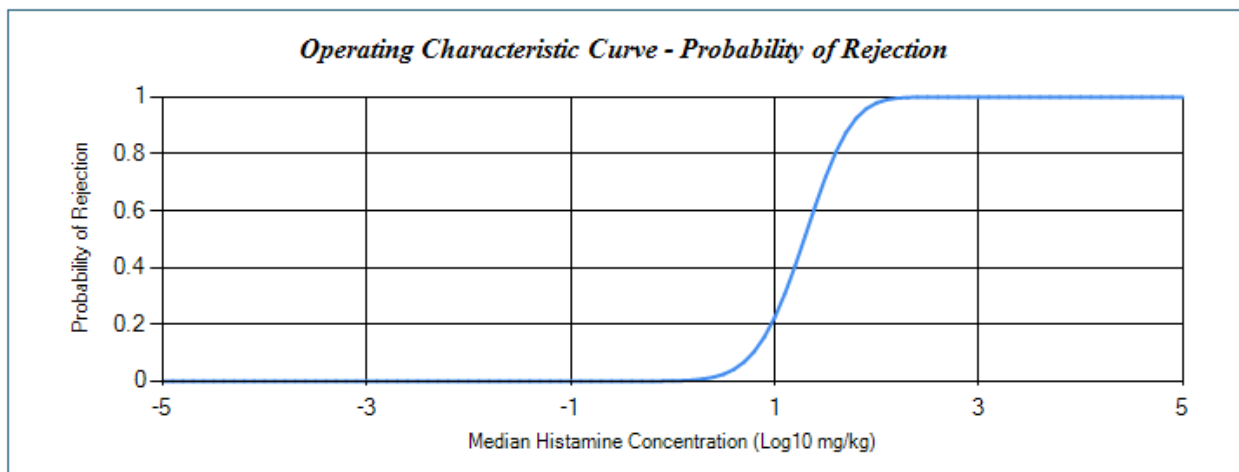
This is the expected standard deviation of the histamine concentration within a lot. It is on the \log_{10} scale. When combined with a \log_{10} mg/kg mean concentration value, it is used to generate a log-normal distribution of histamine concentration within the lot.

Results

The following results are displayed:

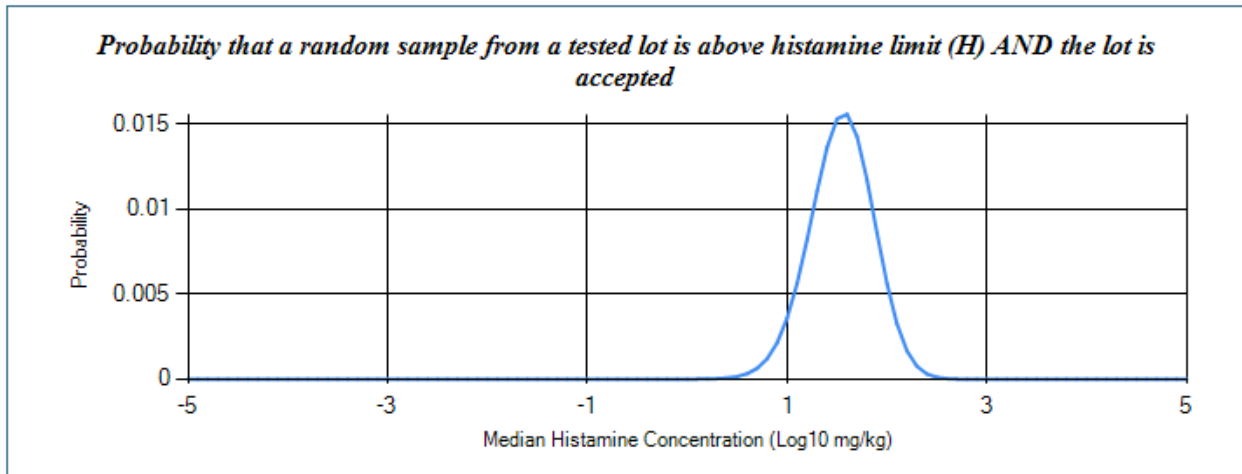
Operating Characteristic Curve - Probability of Rejection

This chart displays the probability of rejecting a given lot when tested using the sampling plan specified above (3 samples, none of which should exceed 50mg/kg). It evaluates the plan using different assumptions for the \log_{10} mean histamine concentration, ranging from -5 to + 5 \log_{10} mg/kg, and using the standard deviation supplied by the user.



Probability that a random sample from a tested lot is above the histamine limit AND the lot is accepted

The following chart displays the probability that a random sample taken from a tested lot would be above the histamine limit (H), and where the lot is accepted by the defined sampling plan. To the left of the graph, the sample is very unlikely to be above H while the lot is likely to be accepted. To the right of the graph, the lot is sure to contain samples above H, while the lot is very likely to be rejected. The middle section indicates a point of vulnerability where there is an elevated probability of a lot being both accepted and having some probability of having a random sample above H.



Application of the Tool: Design a Plan Example Cases

Case 1: Sardines in the Market of Country X

For this example, the standard deviation of histamine in sardines is set to $0.38 \log_{10}$. Two scenarios are considered: a level of protection of 1 in 1,000 and 1 in 10,000 where the histamine limit is 200mg/kg. In both cases, a 98% confidence limit is assumed. It has been decided that the maximum number of samples to be tested is 20 and that all samples should meet the proposed criterion. The definition of the parameters in the tool for the two scenarios and the range of possible sampling plans are shown below.

Scenario A: Level of Protection of 1 in 1,000

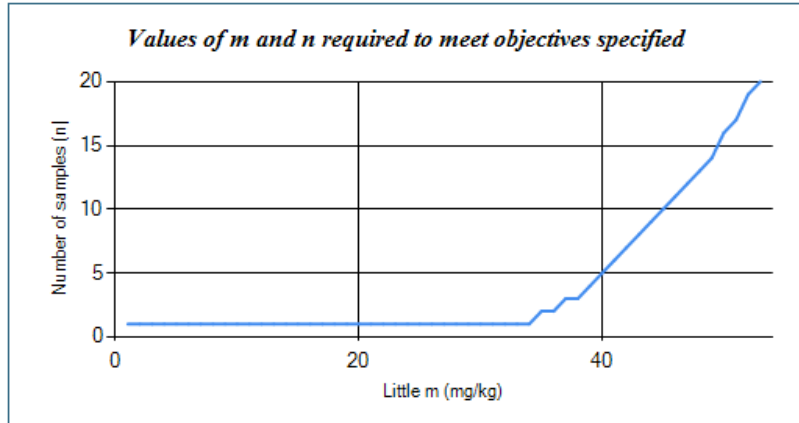
Parameters:

Parameter	Value	Allowable Range
Histamine Limit (H) (mg/kg):	<input type="text" value="200"/>	(10 to 500)
Level of Protection:	1 in <input type="text" value="1000"/>	(100 to 10000)
Confidence Limit (%):	<input type="text" value="98"/>	(90 to 99)
<hr/>		
Standard Deviation (\log_{10}):	<input type="text" value="0.38"/>	(0.1 to 2.0)
Acceptable number of samples above little m (c):	<input type="text" value="0"/>	(0 to 5)
Maximum samples (n_{\max}) to test:	<input type="text" value="20"/>	(3 to 50)

Results:

The following table and chart show the minimum required number of samples to be tested, n , at different concentration thresholds, little m , to achieve the objectives specified above.

Number of samples (n)	m (mg/kg)
1	1
2	35
3	37
4	39
5	40
6	41
7	42
8	43
9	44
10	45
11	46
12	47
13	48
14	49
16	50
17	51
19	52
20	53



Scenario B: Level of Protection of 1 in 10,000

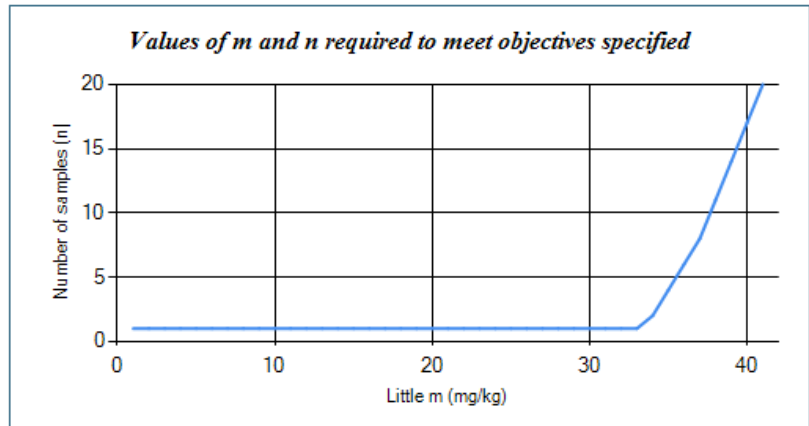
Parameters:

Parameter	Value	Allowable Range
Histamine Limit (H) (mg/kg):	<input type="text" value="200"/>	(10 to 500)
Level of Protection:	1 in <input type="text" value="10000"/>	(100 to 10000)
Confidence Limit (%):	<input type="text" value="98"/>	(90 to 99)
<hr/>		
Standard Deviation (log ₁₀):	<input type="text" value="0.38"/>	(0.1 to 2.0)
Acceptable number of samples above little m (c):	<input type="text" value="0"/>	(0 to 5)
Maximum samples (n _{max}) to test:	<input type="text" value="20"/>	(3 to 50)

Results:

The following table and chart show the minimum required number of samples to be tested, n , at different concentration thresholds, little m , to achieve the objectives specified above.

Number of samples (n)	m (mg/kg)
1	1
2	34
4	35
6	36
8	37
11	38
14	39
17	40
20	41



Conclusions

From the results above, it can be seen that an increase in level of protection requires a decrease in the value of m for most values of n , or an increase in the number of samples for the same value of little m .

Case 2: Canned Tuna imports to Country Y from a Private Company

For this example, the standard deviation of histamine in canned tuna is set to 1.32 \log_{10} . Two scenarios are considered: a level of protection of 1 in 1,000 and 1 in 10,000 where the histamine limit is 200mg/kg. In both cases, a 98% confidence limit is assumed. It has been decided that the maximum number of samples to be tested is 20 and that all samples should meet the proposed criterion.

The definition of the parameters in the tool for the two scenarios and the range of possible sampling plans are shown below.

Scenario A: Level of Protection of 1 in 1,000

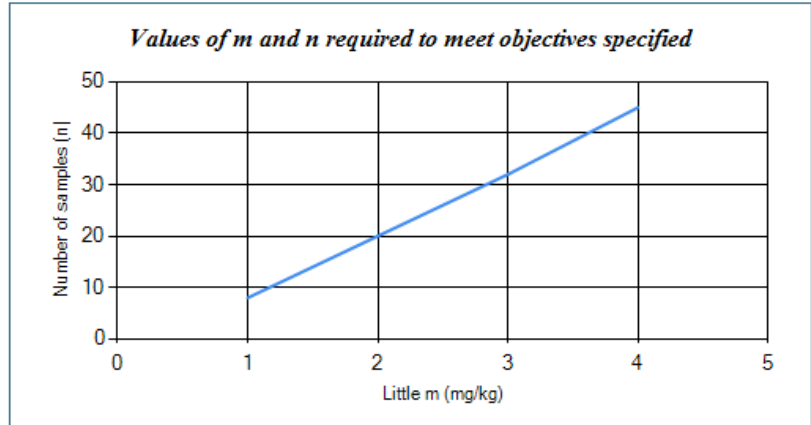
Parameters:

Parameter	Value	Allowable Range
Histamine Limit (H) (mg/kg):	<input type="text" value="200"/>	(10 to 500)
Level of Protection:	1 in <input type="text" value="1000"/>	(100 to 10000)
Confidence Limit (%):	<input type="text" value="98"/>	(90 to 99)
<hr/>		
Standard Deviation (\log_{10}):	<input type="text" value="1.32"/>	(0.1 to 2.0)
Acceptable number of samples above little m (c):	<input type="text" value="0"/>	(0 to 5)
Maximum samples (n_{max}) to test:	<input type="text" value="50"/>	(3 to 50)

Results:

The following table and chart show the minimum required number of samples to be tested, n , at different concentration thresholds, little m , to achieve the objectives specified above.

Number of samples (n)	m (mg/kg)
8	1
20	2
32	3
45	4



Scenario B: Level of Protection of 1 in 10,000

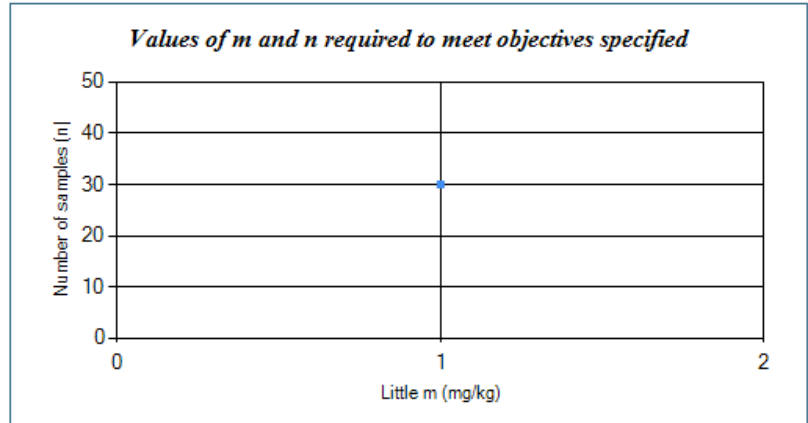
Parameters:

Parameter	Value	Allowable Range
Histamine Limit (H) (mg/kg):	<input type="text" value="200"/>	(10 to 500)
Level of Protection:	1 in <input type="text" value="10000"/>	(100 to 10000)
Confidence Limit (%):	<input type="text" value="98"/>	(90 to 99)
<hr/>		
Standard Deviation (log₁₀):	<input type="text" value="1.32"/>	(0.1 to 2.0)
Acceptable number of samples above little m (c):	<input type="text" value="0"/>	(0 to 5)
Maximum samples (n_{max}) to test:	<input type="text" value="50"/>	(3 to 50)

Results:

The following table and chart show the minimum required number of samples to be tested, n, at different concentration thresholds, little m, to achieve the objectives specified above.

Number of samples (n)	m (mg/kg)
30	1



In this case, only one combination was found.

Conclusion

From the results above, the increase in level of protection requires an increase in the number of samples required at most values of m.

Application of the Tool: Analyze a Plan Example Cases

Case 1: Sardines in the Market of Country A

For this example, the standard deviation of histamine in sardines is set to 0.38 \log_{10} . For the purposes of this example, we would like to compare the results of two plans generated by the design a plan tool for a level of protection of 1 in 1,000.

Number of samples (n)	m (mg/kg)
5	40
10	45

Plan 1: n = 5, m = 40

Parameters

Parameter	Value	Allowable Range
Number of samples (n):	<input type="text" value="5"/>	(1 to 100)
Little m (mg/kg):	<input type="text" value="40"/>	(1 to 200)
Acceptable number of samples above little m (c):	<input type="text" value="0"/>	(0 to 5)

Include Big M:

Optional: a second concentration parameter, Big M, is included for three-class sampling plans. If a single sample has a concentration higher than Big M, the lot is rejected.

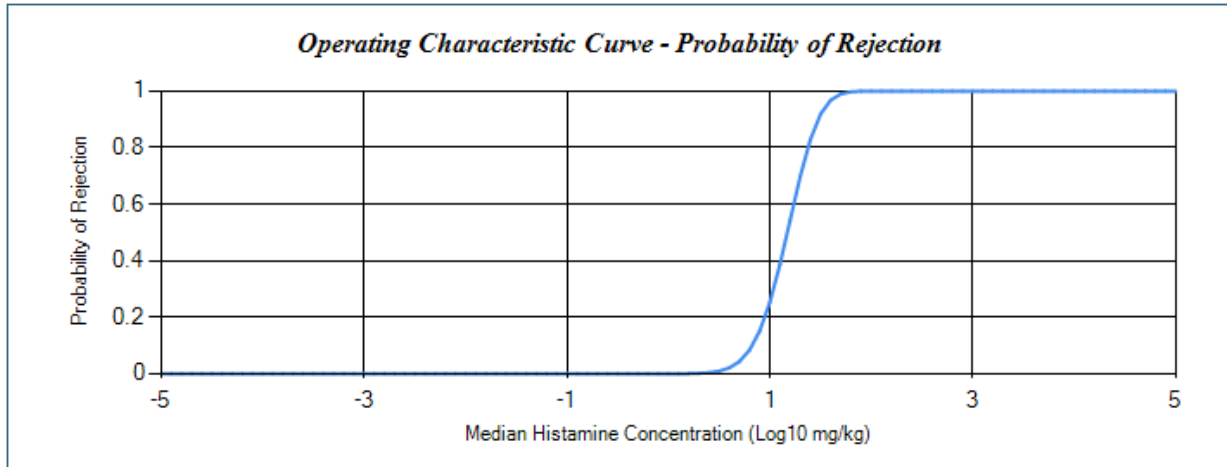
Concentration Threshold for Unacceptability (M) (mg/kg):	<input type="text" value="200"/>	(10 to 500)
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Histamine Limit (H) (mg/kg):	<input type="text" value="200"/>	(10 to 500)
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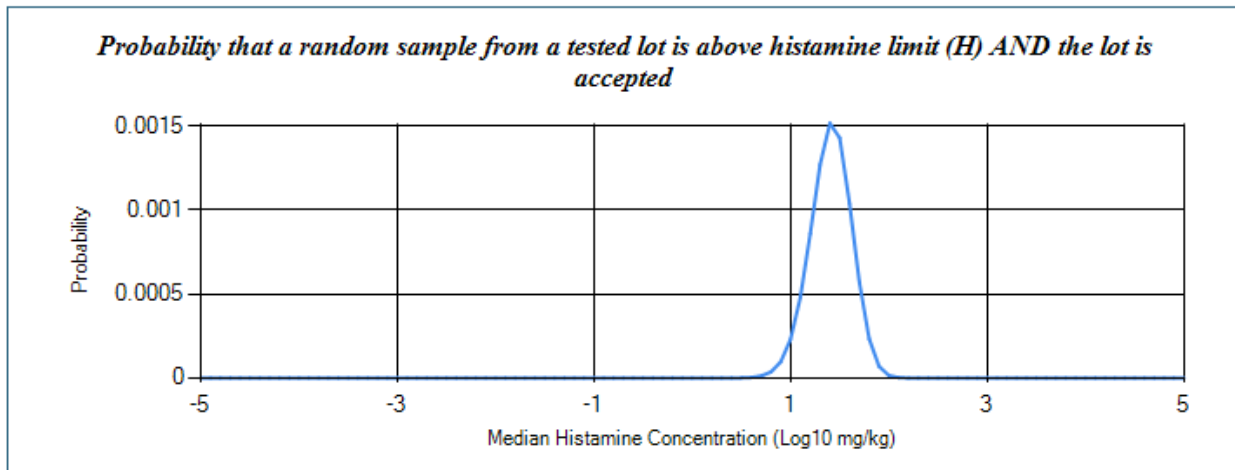
Standard Deviation (\log_{10}):	<input type="text" value="0.38"/>	(0.1 to 2.0)
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Results

The following chart displays the probability of rejecting a given lot when tested using the sampling plan specified above. It evaluates the plan using different assumptions for \log_{10} mean histamine concentration and using the standard deviation supplied by the user.



The following chart displays the probability that a random sample taken from a tested lot would be above the histamine limit (H), and where the lot is accepted by the defined sampling plan. To the left of the graph, the sample is very unlikely to be above H while the lot is likely to be accepted. To the right of the graph, the lot is sure to contain samples above H, while the lot is very likely to be rejected. The middle section indicates a point of vulnerability where there is an elevated probability of a lot being both accepted and having some probability of having a random sample above H.



Plan 2: n = 10, m = 45

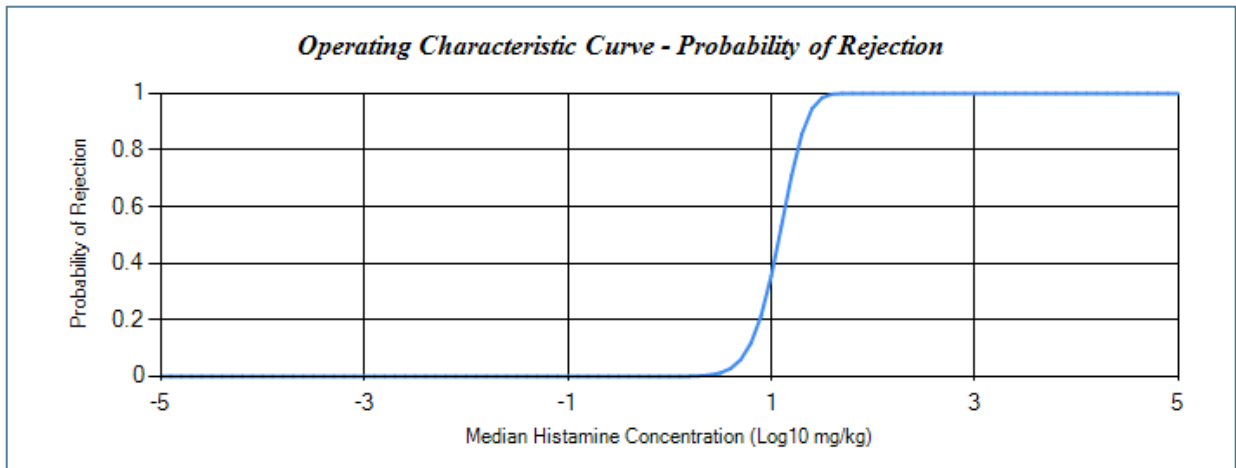
Parameters

Parameter	Value	Allowable Range
Number of samples (n):	<input type="text" value="10"/>	(1 to 100)
Little m (mg/kg):	<input type="text" value="45"/>	(1 to 200)

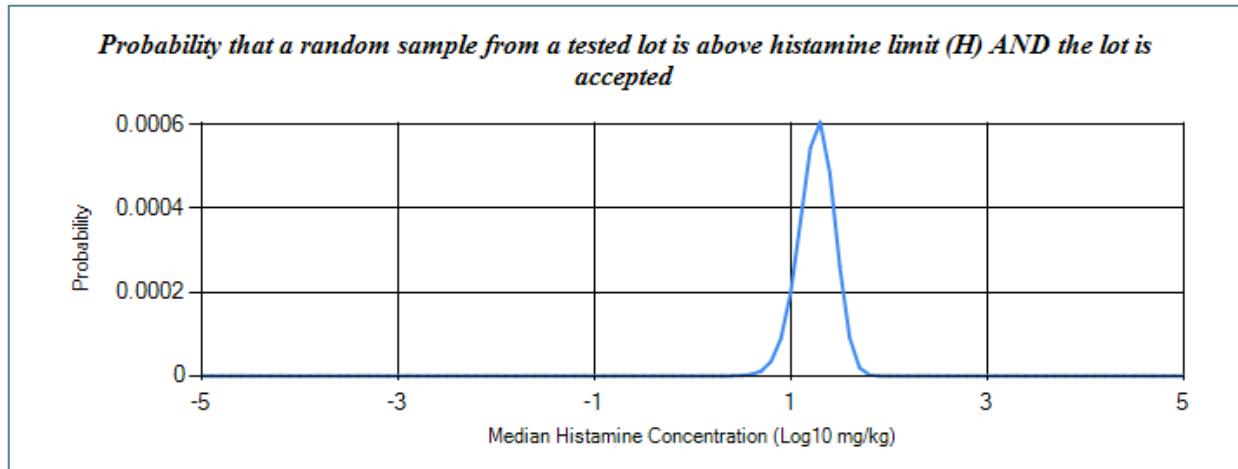
The remainder stay the same as the previous example.

Results

The following chart displays the probability of rejecting a given lot when tested using the sampling plan specified above. It evaluates the plan using different assumptions for \log_{10} mean histamine concentration and using the standard deviation supplied by the user.



The following chart displays the probability that a random sample taken from a tested lot would be above the histamine limit (H), and where the lot is accepted by the defined sampling plan. To the left of the graph, the sample is very unlikely to be above H while the lot is likely to be accepted. To the right of the graph, the lot is sure to contain samples above H, while the lot is very likely to be rejected. The middle section indicates a point of vulnerability where there is an elevated probability of a lot being both accepted and having some probability of having a random sample above H.



Conclusion

From the results above, it can be seen that the probability of rejection at a median lot histamine concentration of 1 \log_{10} mg/kg, for example, is higher for the second plan.

Case 2: Canned Tuna imports to Country B from a Private Company

For this example, the standard deviation of histamine in canned tuna is set to 1.32. For the purposes of this example, we will compare the results of two plans generated by the design a plan tool for a level of protection of 1 in 1,000.

Number of samples (n)	m (mg/kg)
20	2
45	4

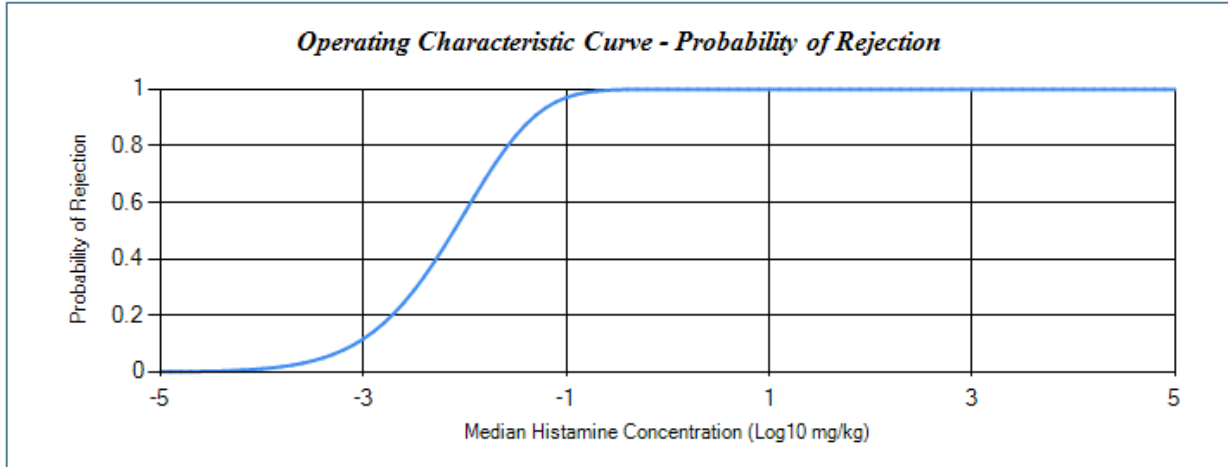
Plan 1: n =20, m = 2

Parameters

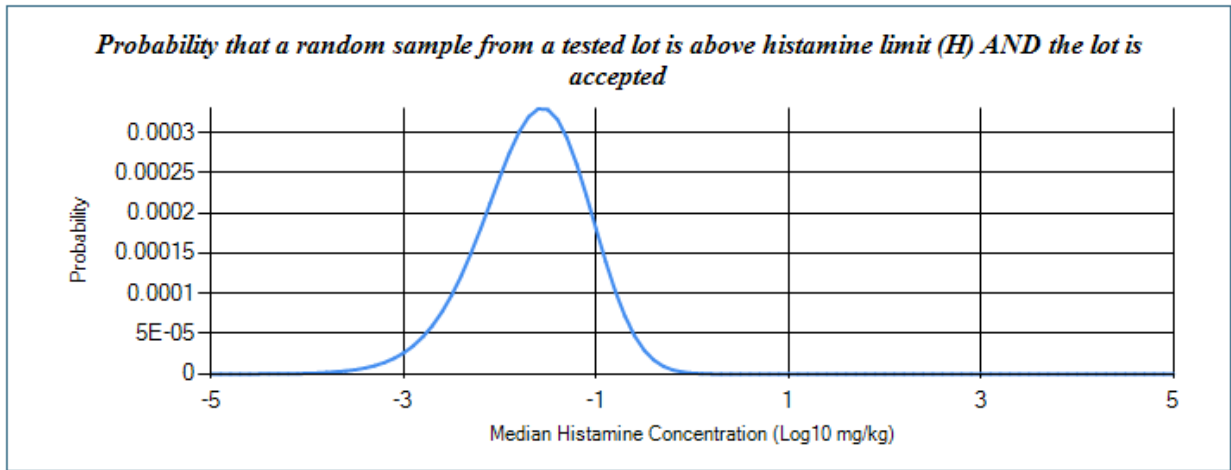
Parameter	Value	Allowable Range
Number of samples (n):	<input type="text" value="20"/>	(1 to 100)
Little m (mg/kg):	<input type="text" value="2"/>	(1 to 200)
Acceptable number of samples above little m (c):	<input type="text" value="0"/>	(0 to 5)
Include Big M:	<input type="text" value="No"/> <input type="button" value="v"/>	
Optional: a second concentration parameter, Big M, is included for three-class sampling plans. If a single sample has a concentration higher than Big M, the lot is rejected.		
Concentration Threshold for Unacceptability (M) (mg/kg):	<input type="text" value="200"/>	(10 to 500)
<hr/>		
Histamine Limit (H) (mg/kg):	<input type="text" value="200"/>	(10 to 500)
Standard Deviation (log ₁₀):	<input type="text" value="1.32"/>	(0.1 to 2.0)

Results

The following chart displays the probability of rejecting a given lot when tested using the sampling plan specified above. It evaluates the plan using different assumptions for log₁₀ mean histamine concentration and using the standard deviation supplied by the user.



The following chart displays the probability that a random sample taken from a tested lot would be above the histamine limit (H), and where the lot is accepted by the defined sampling plan. To the left of the graph, the sample is very unlikely to be above H while the lot is likely to be accepted. To the right of the graph, the lot is sure to contain samples above H, while the lot is very likely to be rejected. The middle section indicates a point of vulnerability where there is an elevated probability of a lot being both accepted and having some probability of having a random sample above H.



Plan 2: $n = 45$, $m = 4$

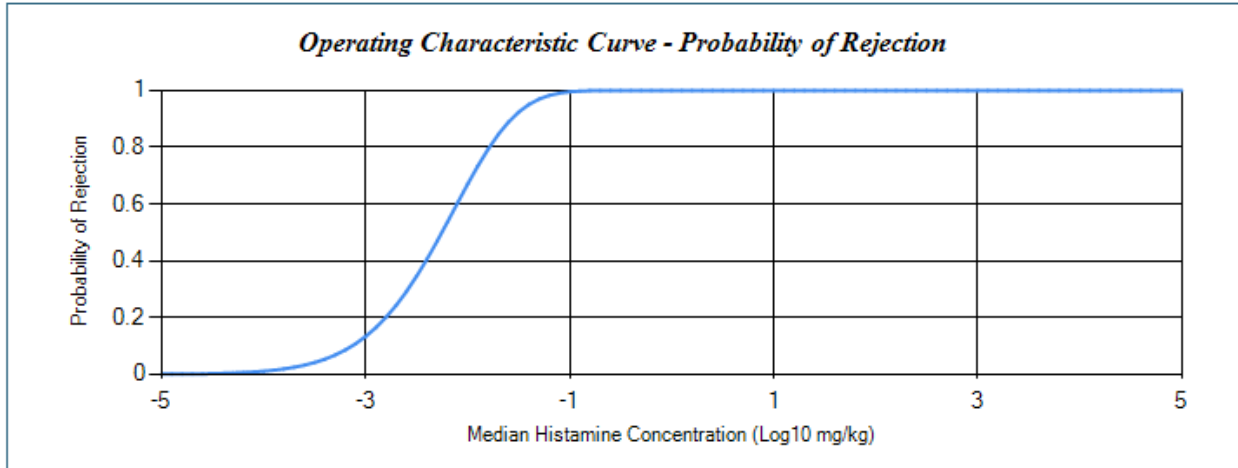
Parameters

Parameter	Value	Allowable Range
Number of samples (n):	<input type="text" value="45"/>	(1 to 100)
Little m (mg/kg):	<input type="text" value="4"/>	(1 to 200)

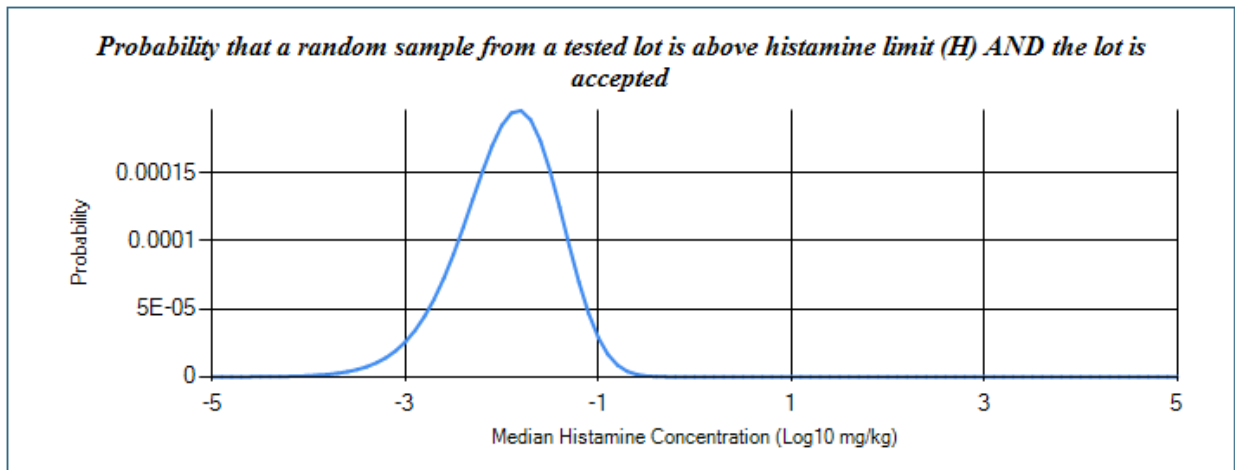
The remainder stay the same as the previous example.

Results

The following chart displays the probability of rejecting a given lot when tested using the sampling plan specified above. It evaluates the plan using different assumptions for \log_{10} mean histamine concentration and using the standard deviation supplied by the user.



The following chart displays the probability that a random sample taken from a tested lot would be above the histamine limit (H), and where the lot is accepted by the defined sampling plan. To the left of the graph, the sample is very unlikely to be above H while the lot is likely to be accepted. To the right of the graph, the lot is sure to contain samples above H, while the lot is very likely to be rejected. The middle section indicates a point of vulnerability where there is an elevated probability of a lot being both accepted and having some probability of having a random sample above H.



Conclusion

From the results above, it can be seen that the probability of rejection for both plans are very similar over the range of median histamine concentrations.