

# Combination strengths



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## Overview

Xray Test Case Designer allows to use different coverage settings, learn the strategies behind using it.

In the next scenario we focus on ordering a coffee, but there are many ways to order this beloved drink. A barista, for instance, would need to be familiar with these combinations. Let's look at what happens when the coverage strength is set to "1-way interactions" (using the dropdown at the top of the Scenarios screen).

E) Drink Combinations (copy) 2

Search...

7 scenarios and 52

1-way interactions

i

#	Drink Type	Cup Type	Drink Size	Caffeine Type	Amount of Espresso	Ristretto shot requested
1	Frozen	not specify a cup type	Short	not specify a caffeine type.	6 Shot - specify a	not request ristretto espresso
2	Frozen	specify for a travel mug.	20-ounce	specify "Half-caf"	specify a Single shot	request ristretto espresso
3	Iced	specify for a travel mug.	Tall	specify "regular"	not specify a ...o shots	not request ristretto espresso
4	Hot	not specify a cup type	Grande	not specify a caffeine type.	not specify a ...o shots	not request ristretto espresso
5	Frozen	specify "for here."	Tall	specify "Decaf"	specify a Double shot	not request ristretto espresso
6	Hot	specify "to go."	Short	not specify a caffeine type.	specify a Triple shot.	request ristretto espresso
7	Iced	specify "for here."	Short	not specify a caffeine type.	specify a Quad shot	request ristretto espresso

### Only seven tests are required to achieve our desired coverage

This means that every test condition was used at least once. This, however, does not guarantee that any parameter values were tested together. In other words, a parameter value merely appearing in this test set is satisfactory as far as Xray Test Case Designer is concerned. That's not particularly thorough.

In this situation, our barista friend might not be prepared for any combination of particular requests when customers place their orders. Search for a combination of the values 'Drink Type = Hot' and 'Drink Size = 20-ounce' together in our set of 7 scenarios. If solely this set of tests were referenced, the barista would be wholly unprepared to make a hot 20-ounce coffee. Let's make sure those two values are together!

When we create a set of 2-way interactions, 39 scenarios are required to achieve our coverage goal of testing every possible PAIR of test conditions:

## E) Drink Combinations (copy) ▾



Search...

39 scenarios and 1,246

2-way interactions ▾



#	Drink Type	Cup Type	Drink Size	Caffeine Type	Amount of Espresso	Ristretto shot requested
1	Frozen	not specify a cup type	Short	not specify a caffeine type.	6 Shot - specify a	not request ristretto espresso
2	Frozen	specify for a travel mug.	20-ounce	specify "Half-caf"	specify a Single shot	request ristretto espresso
3	Iced	specify for a travel mug.	Tall	specify "regular"	not specify a ...o shots	request ristretto espresso
4	Hot	not specify a cup type	Grande	not specify a caffeine type.	not specify a ...o shots	not request ristretto espresso
5	Frozen	specify "for here."	Short	specify "Decaf"	not specify a ...o shots	not request ristretto espresso
6	Iced	specify "to go."	Tall	not specify a caffeine type.	not specify a ...o shots	not request ristretto espresso
7	Hot	specify "for here."	20-ounce	specify "Half-caf"	not specify a ...o shots	request ristretto espresso
8	Hot	not specify a cup type	Grande	specify "Decaf"	specify a Double shot	request ristretto espresso

Although the quantity of tests has increased, the quality and thoroughness of this set has drastically improved as well. By testing every possible pair of test conditions, you have guaranteed that every value has been tested with all other parameters' values.

A hot, 20-ounce drink is guaranteed to appear in your set of tests. 'Drink Type = Hot' and 'Drink Size = Short' has been tested for. 'Hot' and any of the sizes listed have been tested for. Likewise, 'Hot' and any number of espresso shots has been tested. But this concept doesn't just apply to 'Hot'. It applies to 'Frozen,' 'Decaf,' 'Grande,' and any other parameter value in your set of inputs.

These examples go on, but there's a catch: a hot, 20-ounce drink with espresso may not have been included. In 2-way interactions, only pairs have been tested. Enter the 3-way interactions.

221 scenarios achieve the goal of testing every possible "triplet" of test conditions

## E) Drink Combinations (copy) ▾



Search...

221 scenarios and 18,236

3-way interactions ▾



#	Drink Type	Cup Type	Drink Size	Caffeine Type	Amount of Espresso
1	Frozen	not specify a cup type	Short	not specify a caffeine type.	6 Shot - specify a
2	Frozen	specify for a travel mug.	20-ounce	specify "Half-caf"	specify a Single shot
3	Iced	specify for a travel mug.	Tall	specify "regular"	not specify a ...o shots
4	Hot	not specify a cup type	Grande	not specify a caffeine type.	not specify a ...o shots
5	Frozen	specify "for here."	Short	specify "Decaf"	not specify a ...o shots
6	Iced	specify "to go."	Tall	not specify a caffeine type.	not specify a ...o shots
7	Iced	specify "for here."	Grande	specify "Decaf"	specify a Single shot
8	Hot	specify "for here."	Tall	specify "Half-caf"	not specify a ...o shots
9	Hot	specify "to go."	20-ounce	specify "regular"	specify a Double shot

We're sure you've noticed the concerning increase in the number of tests. Thoroughness comes with a price. The more parameter values that you want to be tested together, the more tests there will be.

By increasing the coverage level to "3-way interactions," you have guaranteed that a hot, 20-ounce drink with any number of espresso shots has been included. The same goes for every other possible 3-way interaction in our set of tests.

Let's take this a step further; what if you absolutely needed a hot, 20-ounce drink with a specific number of espresso shots and decaf (or other caffeine type)? Although espresso shots with decaf in the same drink is unlikely in reality, people can have unusual tastes.

You may have also noticed the increased wait time to generate more-thorough scenarios. Not only is the number of tests getting larger, but any margin of error in your System under Test decreases. As you may have guessed, this tradeoff between test quantity and quality continues all the way up to 4-, 5-, and even 6-way interactions. This is because tests will include every quadruplet, quintuplet, and sextuplet of test conditions, respectively.

- **2-way (pairwise) coverage strength**

is often a good default strength for many types of functional tests

- **3-way coverage strength**

overall, could be considered in higher-risk / more "mission-critical" testing. If you are executing tests by hand, rather than execute a complete set of 3-way scenarios, it is often preferable to execute a smaller set of "Mixed-Strength" tests (with 3-way coverage focused on the most important interactions and 2-way coverage for the other parts).

- **4-way and higher coverage strengths**

are rarely used except in situations where (a) all the tests are automated (therefore cheap and quick to execute) and/or (b) the potential risk for error could be extremely disastrous or expensive. For instance, safely sending people into space requires that no errors be made.

If you're considering the pros and cons of, say, executing a smaller number of 2-way tests vs. a larger number of 3-way tests, it is extremely important for you to understand additional test design strategies that you can use to decrease (or increase) the number of tests Xray Test Case Designer generates.



To get a detailed explanation of the difference between less-thorough 2-way (AKA "pairwise" or "all pairs") tests and more-thorough n-way tests, you can hover over the "i" symbol to the right from the strength selection dropdown, then click the "n-way interactions means..."

3-way interactions



Free

ze Caffeine Type

not specify a caffeine type.

We cover all **18,236** possible 3-way interactions in just **221** of a total possible **47,775,744** scenarios.

[3-way interactions means...](#)

Values in *purple italics* can be replaced with any valid value.

## 3-way Interactions Example



Let's use an example to demonstrate what **3-way interactions** means. Your plan, **E) Drink Combinations (copy)**, includes the following parameters and values:

- Drink Type = Hot
- Cup Type = specify for a travel mug.
- Drink Size = Short
- Caffeine Type = specify "Half-caf"

We know that in the generated set of **3-way** tests, you will have at least one test that covers **every** possible interaction involving values from 3 parameters. One example **3-way** test is:

- Drink Type = Hot together with Cup Type = specify for a travel mug. together with Drink Size = Short

So **every** valid **3-way** combination is covered, but it is possible that a valid **4-way** combination is **not** covered. For example, there might **not** be a single test that includes all 4 of the following:

- Drink Type = Hot together with Cup Type = specify for a travel mug. together with Drink Size = Short together with Caffeine Type = specify "Half-caf"

If you would like a more thorough test plan that provides coverage for every valid **4-way** combination such as these, please create a **4-way** test plan by selecting **4-way interactions** from the dropdown menu.

As compared to a **3-way** test plan, a **4-way** test plan is more thorough and better able to detect hard to find defects, but it will take longer to execute the test plan because it has more tests.