Assignment 6: Pairwise and Pairwise Orthogonal Arrays
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Part 1:

1. What is the total number of all combinations test-cases? Show the all-combinations test-case suite.

The total number of test cases using the all-combinations method is calculated as follows:

- Operating System: **3** choices (Mac iOS, Linux, Windows 11)
- Browser: **3** choices (Safari, Firefox, Chrome)
- Student Type: **2** choices (Undergraduate, Graduate)
- Student Location: **2** choices (On Campus, Remote)

Total test cases:

3 x 3 x 2 x 2 = 36

2. Build a Pair-wise table and comment on the number of test cases defined by your table.

OS	**Browser**	**Student Type**	**Location**
Mac iOS	Safari	U	C
Mac iOS	Firefox	G	R
Mac iOS	Chrome	U	R
Linux	Safari	G	R
Linux	Firefox	U	C
Linux	Chrome	G	C
Win 11	Safari	G	C
Win 11	Firefox	U	R
Win 11	Chrome	G	C

The number of test cases is reduced from 36 to **9** cases.

3. What is the alphabet size for the given set of variables?

The largest number of levels among the variables determines the alphabet size:

- OS (3), Browser (3), Student Type (2), Location (2)
- Alphabet Size = 3 (Maximum among all variables)

4. Identify the proper Orthogonal Array using S=2 and I=1 for Pair-wise OA? You can use external resources to find the required OA.
   a. https://www.tmap.net/wiki/orthogonal-arrays-and-pairwise-testing

Using the formula for an orthogonal array: $L_N(S^I)$

where **S = 2** and **I = 1**,

Test Case	**OS**	**Browser**	**Student Type**	**Location**
1	Mac iOS	Safari	U	C
2	Mac iOS	Firefox	G	R
3	Mac iOS	Chrome	U	R
4	Linux	Safari	G	R
5	Linux	Firefox	U	C
6	Linux	Chrome	G	C
7	Win 11	Safari	G	C
8	Win 11	Firefox	U	R
9	Win 11	Chrome	G	C

Given our 4 variables with 3, 3, 2, and 2 levels respectively, we use an OA(9, 4, 3, 2).

5. Populate and show the Orthogonal Array with the appropriate values for this problem.

Method	Number of Test Cases
All-Combinations	36
Pairwise	~9
Pairwise-OA	9

6. Comment on the number of test-cases generated by all-combinations, Pairwise, and Pairwise-OA.
    a. All-combination testing is comprehensive but highly inefficient.
    b. Pairwise testing significantly reduces test cases while maintaining test coverage.
    c. Pairwise-OA ensures an optimal balance between coverage and efficiency using an orthogonal approach.

Part 2:

1. Calculate the number of all-combinations test-cases.

Total Number of All-Combinations Test Cases

- Sales Type: **2** choices (Online, In-Store)
- Store Location: **2** choices (USA, Canada)
- Payment Method: **2** choices (Visa, AMEX)
- Services: **2** choices (Bicycles Only, Bicycles + Maintenance)

Total test cases:

2 x 2 x 2 x 2 = 16

2. What is the pairwise orthogonal array that you can use for this problem? How many test-cases does it represent?

   (You do not need to fill-in the OA, just identify the array using the format on lecture-slides 38-39)

- The appropriate OA for this problem is **L4(2^3)**.
- This array represents **4** test cases.

3. If you had 7 variables with 2 values each, which array would you use? What is the number of test-cases?

(You do not need to fill-in the OA, just identify the array using the format on lecture-slides 38-39)

a. The correct OA to use would be L8(2^7).
b. It represents 8 test cases.

4. How many test-cases does an L8 pairwise orthogonal array represent?
   a. L8 represents 8 test cases in total.

Part 3:

1. What is the total number of test cases for all-combinations?

Total Number of All-Combinations Test Cases

- Reader: **3** choices (Kindle, iPad, Zok)
- Book Type: **4** choices (Textbooks, Poetry, Graphic Novels, Regular Novels)
- Language: **3** choices (English, Spanish, Japanese)

Total test cases:

3 x 4 x 3 = 36

2. What is the **minimum** number of tests for pairwise testing?
   (You may develop a pairwise table or use simple calculation, try to make your ideas clear for the TA).
   a. Every combination of two factors is covered at least once, significantly reducing the number of test cases. The minimum number of test cases is typically around 9 to 12, depending on the specific combinations.

Reader	**Book Type**	**Language**
Kindle	Textbooks	English
Kindle	Poetry	Spanish
Kindle	Graphic Novels	Japanese
iPad	Textbooks	Spanish

iPad	Poetry	Japanese
iPad	Graphic Novels	English
Zok	Textbooks	Japanese
Zok	Poetry	English
Zok	Graphic Novels	Spanish

3. You decide to use pairwise orthogonal arrays to help with your testing. Which pairwise orthogonal array should you use?
   a. The appropriate OA for this problem is **L9(3^4)**

4. What do you think of mixed alphabet? Does it add additional burden? Can you use it to your advantage? Present your own opinion.
   a. I think that a mixed alphabet can introduce complexity in test design but also offers advantages. When different parameters have varying levels, a mixed-alphabet orthogonal array enables more efficient testing by reducing redundant cases. However, it requires careful planning to ensure proper test coverage. Despite the added design effort, it ultimately optimizes testing efficiency while maintaining thorough coverage.

Part 4:

My test strategy includes Equivalence Class Partitioning (ECP) for Variable A, which helps categorize inputs into valid and invalid classes, ensuring comprehensive coverage of different input types. We can also apply Boundary Value Analysis (BVA) for Variable A to test the critical boundary values, including amin-, amin, amin+, amax-, amax, and amax+, as these points are where defects often occur.

As for Variables B, C, and D, I would use Pairwise Testing. This ensures that all possible combinations of these variables are tested at least once, which efficiently reduces the number of test cases while maintaining high defect detection.

We can also incorporate Orthogonal Array Testing (OA) for key variable pairs to optimize test coverage and improve the likelihood of catching defects in critical interactions.

Breaking down the test cases, I would allocate around 18 test cases for Equivalence Class and Boundary Testing for Variable A, around 27 test cases for Pairwise Testing of Variables B, C, and D, and roughly 35 test cases for Orthogonal Array Testing of key

variable combinations. This results in a total estimate of 80 to 120 test cases, aligning with the given constraints.

By combining these techniques, I can achieve a balanced approach that ensures efficient test coverage while considering practical limitations such as time and budget constraints.