

UNIT TEST PACKAGE DOCUMENTATION

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ABSTRACT. This pdf file represents a documentation for Unit Tests package, which related to the math. research

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1. INSTALLATION AND EXECUTION

Prior the unit test execution, one has to download the package `main_definitions.m` from https://github.com/kolosovpetro/research_unit_tests. Installation is done by clicking **File -> Install...**, choose `main_definitions.m` by installing from **source**. Then recall the package `main_definitions.m` in Mathematica notebook using the commands

```
Needs["MainDefinitions"]  
Needs["UnitTests"]
```

2. UNIT TEST 1

Verifies an identity

$$\mathbf{P}_{a,b}^m(n) = \mathbf{P}_b^m(n) - \mathbf{P}_a^m(n)$$

3. UNIT TEST 2

Verifies an identity

$$\mathbf{P}_{a,b}^m(n) = \sum_k \mathbf{X}_k^m(a, b)(-1)^{m-k}n^k$$

4. UNIT TEST 3

Verifies an identity

$$\mathbf{X}_k^m(a, b) = \mathbf{X}_k^m(b) - \mathbf{X}_k^m(a)$$

5. UNIT TEST 4

Verifies an identity

$$\mathbf{X}_t^m(a, b) = (-1)^m \sum_{k=1}^{2m-t+1} \mathbf{H}_{m,t}(k)(b^k - a^k)$$

6. UNIT TEST 5

Verifies an identity

$$\mathbf{P}_{a,b}^m(n) = \sum_k (-1)^{2m-k} \sum_{\ell=1}^{2m-k+1} \mathbf{H}_{m,k}(\ell)(b^\ell - a^\ell)n^k$$

7. UNIT TEST 6

Verifies an identity

$$\mathbf{Q}_{a,b}^r(n) = \mathbf{Q}_b^r(n) - \mathbf{Q}_a^r(n)$$

8. UNIT TEST 7

Verifies an identity

$$(f_t^r * f_t^r)[n] = \mathbf{Q}_{t,n-t+1}^r(n), \quad n \geq 1.$$

9. UNIT TEST 8

Verifies an identity

$$n^{2m+1} + 1 = \sum_{r \geq 0} \mathbf{A}_{m,r}(f_0^r * f_0^r)[n], \quad n > 0, \quad n \in \mathbb{N}$$

10. UNIT TEST 9

Verifies an identity

$$n^{2m+1} - 1 = \sum_{r \geq 0} \mathbf{A}_{m,r}(f_1^r * f_1^r)[n], \quad n > 0, \quad n \in \mathbb{N}$$

11. UNIT TEST 10

Verifies an identity

$$\mathbf{X}_t^m(a, b) = (-1)^m \sum_{j=t}^m \mathbf{A}_{m,j}(-1)^j \binom{j}{t} (S_{2j-t}(b) - S_{2j-t}(a))$$

12. UNIT TEST 11

Verifies an identity

$$\mathbf{P}_{a,b}^m(n) = \sum_k \sum_{j \geq k} (-1)^{2m+j-k} \mathbf{A}_{m,j} \binom{j}{k} (S_{2j-k}(b) - S_{2j-k}(a)) n^k$$

13. UNIT TEST 12

Verifies an identity

$$\mathbf{P}_{a+b}^m(a+b) \equiv \sum_k \binom{2m+1}{k} a^{2m+1-k} b^k$$

14. UNIT TEST 13

Verifies an identity

$$n^{2m+1} = \mathbf{P}_n^m(n)$$

15. UNIT TEST 14

Verifies an identity

$$n^s = n^{[s \text{ is even}]} \mathbf{P}_n^{\lfloor \frac{s-1}{2} \rfloor}(n)$$

16. UNIT TEST 15

Verifies an identity

$$\mathbf{P}_{t,n-t+1}^m(n) = \sum_r \mathbf{A}_{m,r} \mathbf{Q}_{t,n-t+1}^r(n) \equiv \sum_r \mathbf{A}_{m,r} (f_t^r * f_t^r)[n], \quad n \geq 1.$$

17. UNIT TEST 16

Verifies an identity

$$\mathbf{P}_n^m(n) - \mathbf{P}_{1,n+1}^m(n) = 1$$