One-Sample Sign Test (ts_sign_os)

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Introduction

The *ts_sign_os* function performs one-sample sign test.

This document contains the details on how to use the functions, and formulas used in them.

1 About the Function

1.1 Input parameters:

- **data**
  the data as numbers.
  - *Excel* as a fixed range,
  - *Python* as a pandas data series
  - *R* as a vector

- *Optional parameters*
  - **hypMed**
    the hypothesized median to be used. The default will use the mid-range of the data

1.2 Output

- **pVal**
  The p-value (significance) of the test, two tailed

- **testUsed**
  A description of the test used

Note for *Excel:*
the array function *ts_sign_os_arr* will require 2 rows and 2 columns.

1.3 Dependencies

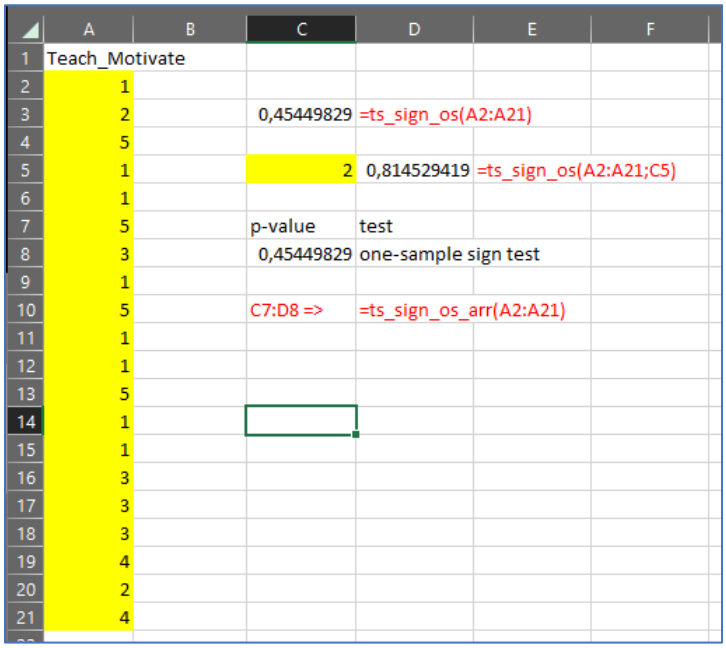
- **Excel**
  None.
  You can run the **ts_sign_os_addHelp** macro so that the function will be available with some help in the 'User Defined' category in the functions overview.

- **Python**
  The following libraries are needed:
  - pandas is needed for data entry and showing the results.
  - The binom function from scipy's library stats for the binomial distribution

- **R**
  No other libraries required.

2 Examples

2.1 Excel



	A	B	C	D	E	F
1	Teach_Motivate					
2	1					
3	2		0,45449829	=ts_sign_os(A2:A21)		
4	5					
5	1		2	0,814529419	=ts_sign_os(A2:A21;C5)	
6	1					
7	5		p-value	test		
8	3		0,45449829	one-sample sign test		
9	1					
10	5		C7:D8 =>	=ts_sign_os_arr(A2:A21)		
11	1					
12	1					
13	5					
14	1					
15	1					
16	3					
17	3					
18	3					
19	4					
20	2					
21	4					

2.2 Python

```
dataList = [1, 2, 5, 1, 1, 5, 3, 1, 5, 1, 1, 5, 1, 1, 3, 3, 3, 4, 2, 4]
data = pd.Series(dataList)

ts_sign_os(data)
```

	p-value	test
0	0.454498	one-sample sign test

```
ts_sign_os(data, hypMed=2)
```

	p-value	test
0	0.814529	one-sample sign test

2.3 R

```
> data <- c(1, 2, 5, 1, 1, 5, 3, 1, 5, 1, 1, 5, 1, 1, 3, 3, 3, 4, 2, 4)
> ts_sign_os(data)
       pVal             testUsed
1 0.4544983 one-sample sign test
> ts_sign_os(data, hypMed = 2)
       pVal             testUsed
1 0.8145294 one-sample sign test
```

3 Details of Calculations

$$sig. = 2 \times B\left(n, \min(n_+, n_-), \frac{1}{2}\right)$$

Symbols

- $B(\dots)$ is the binomial cumulative distribution function
- n is the number of cases
- n_+ is the number of cases above the hypothesized median
- n_- is the number of cases below the hypothesized median
- $\min$ is the minimum value of the two values

4 Source

The test is described in Stewart (1941), although there might be earlier uses:

> **1. Introduction.** Let us consider a set of N non-zero differences, of which x are positive and $N - x$ are negative; and suppose that the hypothesis tested, H_0, implies, in independent sampling, that x will be distributed about an expected value of $N/2$ in accordance with the binomial $(\frac{1}{2} + \frac{1}{2})^N$. As a quick test of H_0, we may choose to test the hypothesis h_0 that x has the above probability distribution. Defining r to be the smaller of x and $N - x$, the test consists in rejecting h_0 and therefore H_0 whenever $r \leq r(\epsilon, N)$, where $r(\epsilon, N)$ is determined by N and the significance level ϵ.

(Stewart, 1941, p. 236)

References

Stewart, W. M. (1941). A note on the power of the sign test. *The Annals of Mathematical Statistics*, *12*(2), 236–239. https://doi.org/10.1214/aoms/1177731755