

### Problem 3: Compare two groups

It is often important to determine if a monitored variable is significantly higher, lower, or the same between two locations or two periods (e.g., before and after implementation of treatment). This example demonstrates two statistical tests – one parametric, one nonparametric – to assess with statistical confidence whether two data groups are significantly different.

#### a. Student's t-Test

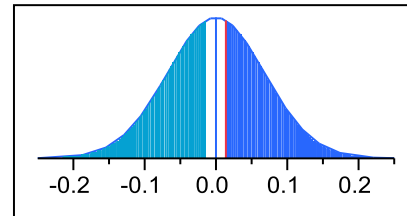
Using Dataset 1 in file Sampledata.xlsx, and assuming that log-transformed data satisfy all requirements for parametric statistical analysis, use a Student's t-Test to test the hypothesis that mean TP export at Station 2 (mean of log-transformed values of TPX\_2) did not differ significantly in the Calibration and Treatment periods (Period=CAL and TRT, respectively). In this case we are using a two-tailed t-Test, i.e., we are interested in whether the means of the two groups are different in either direction, not specifically if one group is significantly higher or lower than the other.

logTPX

#### t Test

TRT-CAL

Difference	0.01390	t Ratio	0.204541
Std Err Dif	0.06796	DF	331
		Prob >  t	0.8381



#### Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
CAL	181	1.07870	0.570200	0.04238	0.99507	1.1623
TRT	152	1.09260	0.669912	0.05434	0.98524	1.2000

The low t statistic (0.20) and associated  $P$  (0.84) indicate that we cannot reject the hypothesis that mean TP export measured at Station 2 during the Calibration (1.08) and Treatment (1.09) periods did not differ significantly.

#### b. Wilcoxon/Kruskal-Wallis

Using Dataset 1, apply the nonparametric Wilcoxon/Kruskal-Wallis test on raw (non-transformed) data to test the hypothesis that mean TP export at Station 2 (TPX\_2) in the Calibration and Treatment periods did not differ significantly.

#### Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Period	N	Median	Ave Rank	Z
CAL	181	7.992	167.4	0.09
TRT	152	8.917	166.5	-0.09
Overall	333		167.0	

$H = 0.01$   $DF = 1$   $P = 0.930$

The  $P$  value indicates that we cannot reject the hypothesis that mean TP export measured at Station 2 did not differ significantly between the Calibration and Treatment periods.