# ANOVA

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| *Completely Randomized Design**Randomized Block Design**Factorial Design* |

# Factorial Design

In a factorial design, there are more than one factors under consideration in the experiment. The test subjects are assigned to treatment levels of every factor combinations at random.

<http://www.r-tutor.com/elementary-statistics/analysis-variance/factorial-design>

***Example***

A fast food franchise is test marketing 3 new menu items in both East and West Coasts of continental United States. To find out if they the same popularity, 12 franchisee restaurants from each Coast are randomly chosen for participation in the study.

In accordance with the factorial design, within the 12 restaurants from East Coast, 4 are randomly chosen to test market the first new menu item, another 4 for the second menu item, and the remaining 4 for the last menu item. The 12 restaurants from the West Coast are arranged likewise.

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| av = aov(r ~ tm1 \* tm2)  > summary(av)  Df Sum Sq Mean Sq F value Pr(>F)  tm1 2 385 193 9.55 0.0015 \*\*  tm2 1 715 715 35.48 1.2e-05 \*\*\*  tm1:tm2 2 234 117 5.81 0.0113 \*  Residuals 18 363 20 |

Since the p-value of 0.0015 for the menu items is less than the .05 significance level, we reject the null hypothesis that the mean sales volume of the new menu items are all equal.

Moreover, the p-value of 1.2e-05 for the east-west coasts comparison is also less than the .05 significance level.

It shows there is a difference in overall sales volume between the coasts. Finally, the last p-value of 0.0113 (< 0.05) indicates that there is a possible interaction between the menu item and coast location factors, i.e., customers from different coastal regions have different tastes.

# Randomized Block Design

In a ***randomized block design***, there is only one primary factor under consideration in the experiment. Similar test subjects are grouped into ***blocks***.

Each block is tested against all treatment levels of the primary factor at random order. This is intended to eliminate possible influence by other extraneous factors.