

Statistical Tests Guide by Variable Type

Single Variable Analysis (Descriptive)

Variable Type	Statistical Test/Measure	Purpose	Example
Nominal	Frequency counts, Mode, Chi-square goodness of fit	Describe distribution	Gender distribution in sample
Ordinal	Frequency counts, Mode, Median	Describe central tendency	Education level distribution
Discrete	Mean, Median, Mode, Standard deviation, Frequency distribution	Describe distribution and variability	Number of children per family
Continuous	Mean, Median, Standard deviation, Histogram, Normality tests	Describe distribution and variability	Height measurements

Two Variable Analysis (Relationships)

Categorical vs Categorical

Independent Variable	Dependent Variable	Statistical Test	Purpose	Example
Nominal	Nominal	Chi-square test of independence	Test association	Gender vs Political party
Nominal	Ordinal	Chi-square test, Mann-Whitney U	Test association/difference	Gender vs Satisfaction rating
Ordinal	Ordinal	Spearman's rank correlation	Test correlation	Education level vs Income bracket

Categorical vs Numerical

Independent Variable	Dependent Variable	Statistical Test	Purpose	Example
Nominal (2 groups)	Continuous	Independent t-test	Compare means	Gender vs Height
Nominal (3+ groups)	Continuous	One-way ANOVA	Compare means	Blood type vs Cholesterol level
Ordinal	Continuous	Kruskal-Wallis test	Compare distributions	Education level vs Income
Nominal (2 groups)	Discrete	Mann-Whitney U test	Compare distributions	Gender vs Number of siblings

Numerical vs Numerical

Independent Variable	Dependent Variable	Statistical Test	Purpose	Example
Continuous	Continuous	Pearson correlation, Linear regression	Test correlation/prediction	Height vs Weight
Discrete	Continuous	Spearman correlation, Regression	Test relationship	Number of study hours vs Test score
Continuous	Discrete	Poisson regression	Predict count data	Temperature vs Number of ice cream sales
Discrete	Discrete	Spearman correlation	Test relationship	Number of siblings vs Number of pets

Multiple Variable Analysis (Advanced)

Three or More Variables

Variables	Statistical Test	Purpose	Example
Multiple Categorical	Log-linear analysis	Model complex relationships	Gender × Age group × Political preference
Multiple Continuous	Multiple regression	Predict outcome from multiple factors	Height + Weight + Age → Blood pressure
Mixed Variables	ANCOVA	Compare groups while controlling for covariates	Compare treatment groups controlling for age
Categorical + Multiple Continuous	MANOVA	Compare groups on multiple outcomes	Gender differences in multiple test scores

Special Cases and Assumptions

When Normal Distribution is Violated

Original Test	Non-parametric Alternative	When to Use
Independent t-test	Mann-Whitney U test	Non-normal continuous data, small samples
Paired t-test	Wilcoxon signed-rank test	Non-normal paired data
One-way ANOVA	Kruskal-Wallis test	Non-normal data, unequal variances
Pearson correlation	Spearman rank correlation	Non-linear relationships, ordinal data

Interval vs Ratio Variables

Variable Scale	Available Operations	Appropriate Tests	Example
Interval	Addition, Subtraction (not multiplication/division)	t-tests, ANOVA, Correlation	Temperature in Celsius
Ratio	All arithmetic operations	All parametric tests, meaningful ratios	Height, Weight, Income

Sample Size Considerations

Test Type	Minimum Sample Size	Notes
Chi-square	Expected frequency ≥ 5 in each cell	Use Fisher's exact test for small samples
t-test	$n \geq 30$ per group (or normal distribution)	Smaller samples acceptable if normally distributed
ANOVA	$n \geq 15$ per group	More robust with larger, equal-sized groups
Regression	$n \geq 10$ -15 per predictor variable	More predictors require larger samples

Quick Decision Tree

Start Here: What are you trying to do?

- Describe one variable** → Use descriptive statistics appropriate for variable type
- Compare groups** →
 - 2 groups: t-test or Mann-Whitney U
 - 3+ groups: ANOVA or Kruskal-Wallis
- Test relationships** →
 - Both categorical: Chi-square
 - Both continuous: Correlation/Regression
 - Mixed: Appropriate test from tables above
- Predict outcomes** → Regression analysis (linear, logistic, etc.)

Key Questions to Ask:

- What type of variables do I have?
- Are my data normally distributed?
- Are groups independent or related?
- What is my sample size?
- What assumptions does my chosen test require?