12.13: Choosing the Right Test

Learning Objectives

- This table is designed to help you decide which statistical test or descriptive statistic is appropriate for your experiment. In order to use it, you must be able to identify all the variables in the data set and tell what kind of variables they are.

test	nominal variables	measurement variables	ranked variables	purpose	notes	example
Exact test for goodness-of-fit	1	–	–	test fit of observed frequencies to expected frequencies	use for small sample sizes (less than 1000)	count the number of red, pink and white flowers in a genetic cross, test fit to expected $1:2:1$ ratio, total sample <1000
Chi-square test of goodness-of-fit	1	–	–	test fit of observed frequencies to expected frequencies	use for large sample sizes (greater than 1000)	count the number of red, pink and white flowers in a genetic cross, test fit to expected $1:2:1$ ratio, total sample >1000
G–test of goodness-of-fit	1	–	–	test fit of observed frequencies to expected frequencies	used for large sample sizes (greater than 1000)	count the number of red, pink and white flowers in a genetic cross, test fit to expected $1:2:1$ ratio, total sample >1000
Repeated *G*–tests of goodness-of-fit	2	–	–	test fit of observed frequencies to expected frequencies in multiple experiments	-	count the number of red, pink and white flowers in a genetic cross, test fit to expected $1:2:1$ ratio, do multiple crosses
test	nominal variables	measurement variables	ranked variables	purpose	notes	example

Fisher's exact test	2	–	–	test hypothesis that proportions are the same in different groups	use for small sample sizes (less than 1000)	count the number of live and dead patients after treatment with drug or placebo, test the hypothesis that the proportion of live and dead is the same in the two treatments, total sample < 1000
Chi-square test of independence	2	–	–	test hypothesis that proportions are the same in different groups	use for large sample sizes (greater than 1000)	count the number of live and dead patients after treatment with drug or placebo, test the hypothesis that the proportion of live and dead is the same in the two treatments, total sample > 1000
G–test of independence	2	–	–	test hypothesis that proportions are the same in different groups	large sample sizes (greater than 1000)	count the number of live and dead patients after treatment with drug or placebo, test the hypothesis that the proportion of live and dead is the same in the two treatments, total sample > 1000

Cochran-Mantel-Haenszel test	3	–	–	test hypothesis that proportions are the same in repeated pairings of two groups	alternate hypothesis is a consistent direction of difference	count the number of live and dead patients after treatment with drug or placebo, test the hypothesis that the proportion of live and dead is the same in the two treatments, repeat this experiment at different hospitals
test	nominal variables	measurement variables	ranked variables	purpose	notes	example
Arithmetic mean	–	1	–	description of central tendency of data	-	-
Median	–	1	–	description of central tendency of data	more useful than mean for very skewed data	median height of trees in forest, if most trees are short seedlings and the mean would be skewed by a few very tall trees
Range	–	1	–	description of dispersion of data	used more in everyday life than in scientific statistics	-
Variance	–	1	–	description of dispersion of data	forms the basis of many statistical tests; in squared units, so not very understandable	-
Standard deviation	–	1	–	description of dispersion of data	in same units as original data, so more understandable than variance	-
Standard error of the mean	–	1	–	description of accuracy of an estimate of a mean	-	-

test	nominal variables	measurement variables	ranked variables	purpose	notes	example
Confidence interval	–	1	–	description of accuracy of an estimate of a mean	-	-
test	nominal variables	measurement variables	ranked variables	purpose	notes	example
One-sample t–test	–	1	–	test the hypothesis that the mean value of the measurement variable equals a theoretical expectation	-	blindfold people, ask them to hold arm at 45° angle, see if mean angle is equal to 45°
Two-sample t–test	1	1	–	test the hypothesis that the mean values of the measurement variable are the same in two groups	just another name for one-way anova when there are only two groups	compare mean heavy metal content in mussels from Nova Scotia and New Jersey
One-way anova	1	1	–	test the hypothesis that the mean values of the measurement variable are the same in different groups	-	compare mean heavy metal content in mussels from Nova Scotia, Maine, Massachusetts, Connecticut, New York and New Jersey
Tukey-Kramer test	1	1	–	after a significant one-way anova, test for significant differences between all pairs of groups	-	compare mean heavy metal content in mussels from Nova Scotia vs. Maine, Nova Scotia vs. Massachusetts, Maine vs. Massachusetts, etc.

Bartlett's test	1	1	–	test the hypothesis that the standard deviation of a measurement variable is the same in different groups	usually used to see whether data fit one of the assumptions of an anova	compare standard deviation of heavy metal content in mussels from Nova Scotia, Maine, Massachusetts, Connecticut, New York and New Jersey
test	nominal variables	measurement variables	ranked variables	purpose	notes	example
Nested anova	2+	1	–	test hypothesis that the mean values of the measurement variable are the same in different groups, when each group is divided into subgroups	subgroups must be arbitrary (model II)	compare mean heavy metal content in mussels from Nova Scotia, Maine, Massachusetts, Connecticut, New York and New Jersey; several mussels from each location, with several metal measurements from each mussel
Two-way anova	2	1	–	test the hypothesis that different groups, classified two ways, have the same means of the measurement variable	-	compare cholesterol levels in blood of male vegetarians, female vegetarians, male carnivores, and female carnivores
Paired *t*–test	2	1	–	test the hypothesis that the means of the continuous variable are the same in paired data	just another name for two-way anova when one nominal variable represents pairs of observations	compare the cholesterol level in blood of people before vs. after switching to a vegetarian diet

Wilcoxon signed-rank test	2	1	–	test the hypothesis that the means of the measurement variable are the same in paired data	used when the differences of pairs are severely non-normal	compare the cholesterol level in blood of people before vs. after switching to a vegetarian diet, when differences are non-normal
test	nominal variables	measurement variables	ranked variables	purpose	notes	example
Linear regression	–	2	–	see whether variation in an independent variable causes some of the variation in a dependent variable; estimate the value of one unmeasured variable corresponding to a measured variable	-	measure chirping speed in crickets at different temperatures, test whether variation in temperature causes variation in chirping speed; or use the estimated relationship to estimate temperature from chirping speed when no thermometer is available
Correlation	–	2	–	see whether two variables covary	-	measure salt intake and fat intake in different people's diets, to see if people who eat a lot of fat also eat a lot of salt
Polynomial regression	–	2	–	test the hypothesis that an equation with X^2, X^3, etc. fits the Y variable significantly better than a linear regression	-	-

Analysis of covariance (ancova)	1	2	–	test the hypothesis that different groups have the same regression lines	first test the homogeneity of slopes; if they are not significantly different, test the homogeneity of the Y-intercepts	measure chirping speed vs. temperature in four species of crickets, see if there is significant variation among the species in the slope or Y-intercept of the relationships
test	nominal variables	measurement variables	ranked variables	purpose	notes	example
Multiple regression	–	$3+$	–	fit an equation relating several X variables to a single Y variable	-	measure air temperature, humidity, body mass, leg length, see how they relate to chirping speed in crickets
Simple logistic regression	1	1	–	fit an equation relating an independent measurement variable to the probability of a value of a dependent nominal variable	-	give different doses of a drug (the measurement variable), record who lives or dies in the next year (the nominal variable)
Multiple logistic regression	1	$2+$	–	fit an equation relating more than one independent measurement variable to the probability of a value of a dependent nominal variable	-	record height, weight, blood pressure, age of multiple people, see who lives or dies in the next year
test	nominal variables	measurement variables	ranked variables	purpose	notes	example

Sign test	2	–	1	test randomness of direction of difference in paired data	-	compare the cholesterol level in blood of people before vs. after switching to a vegetarian diet, only record whether it is higher or lower after the switch
Kruskal–Wallis test	1	–	1	test the hypothesis that rankings are the same in different groups	often used as a non-parametric alternative to one-way anova	40 ears of corn (8 from each of 5 varieties) are ranked for tastiness, and the mean rank is compared among varieties
Spearman rank correlation	–	–	2	see whether the ranks of two variables covary	often used as a non-parametric alternative to regression or correlation	40 ears of corn are ranked for tastiness and prettiness, see whether prettier corn is also tastier