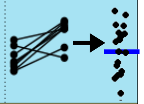
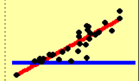
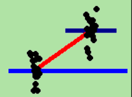
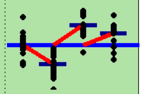
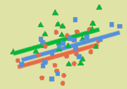
Common tests are linear models

See working examples and more details at the accompanying notebook: https://lindeloev.github.io/tests-as-linear

		Built-in function in R	Equivalent linear model in R	if N	The model in words	Icon
Simple regression: lm(y ~ 1 + x)	**y is independent of x** P: One-sample t-test N: Wilcoxon signed-rank	W or L: t.test(y) W or L: wilcox.test(y)	W or L: lm(y ~ 1) W or L: lm(signed_rank(y) ~ 1)	[≥14]	One number (intercept) predicts **y**. One number (intercept) predicts the signed rank of **y**.	
	P: Paired-sample t-test N: Wilcoxon matched pairs	W: t.test(y_1, y_2, paired=TRUE) W: wilcox.test(y_1, y_2, paired=TRUE)	W: lm(y_2 - y_1 ~ 1) W: lm(signed_rank(y_2 - y_1) ~ 1)	[≥14]	One intercept predicts the pairwise **y_2-y_1** differences. One intercept predicts the pairwise difference in the signed rank of **y_2-y_1**.	
	y ~ continuous x P: Pearson correlation N: Spearman correlation	W: cor.test(x, y, method='Pearson') W: cor.test(x, y, method='Spearman')	W: lm(y ~ 1 + x) W: lm(rank(y) ~ 1 + rank(x))	[≥10]	**x** multiplied by a number (slope) predicts **y**. The rank of **x** multiplied by a number (slope) predicts the rank of **y**.	
	y ~ discrete x P: Two-sample t-test P: Welch's t-test N: Mann-Whitney U	W: t.test(y_1, y_2, var.equal=TRUE) W: t.test(y_1, y_2, var.equal=FALSE) W: wilcox.test(y_1, y_2)	L: lm(y ~ 1 + G_2)[A] L: gls(y ~ 1 + G_2, weights=...[B])[A] L: lm(signed_rank(y) ~ 1 + G_2)[A]	[≥11]	One intercept per **group** (i.e., per **x**) predicts **y**. One intercept per **group** (i.e., per **x**) predicts **y** (but different variances). One intercept per **group** (i.e., per **x**) predicts the signed rank of **y**.	
Multiple regression: lm(y ~ 1 + x_1 + x_2 + ...)	P: One-way ANOVA N: Kruskall-Wallis	L: aov(y ~ group) L: kruskal.test(y ~ group)	L: lm(y ~ 1 + G_2 + G_3 +...+ G_N)[A] L: lm(rank(y) ~ 1 + G_2 + G_3 +...+ G_N)[A]	[≥11]	One intercept per **group** (i.e., per **x**) predicts **y**. One intercept per **group** (i.e., per **x**) predicts the signed rank of **y**.	
	P: One-way ANCOVA	L: aov(y ~ group + x)	L: lm(y ~ 1 + G_2 + G_3 +...+ G_N + x)[A]		One intercept per **group** plus **x** multiplied by a number (slope) predicts **y**. Note: this is discrete AND continuous. All ANCOVAs are ANOVAs with a continuous **x**.	
	P: Two-way ANOVA	L: aov(y ~ group * sex)	L: lm(y ~ 1 + G_2 + G_3 + ... + G_N + S_2 + S_3+ ... + S_K + G_2*S_2+G_3*S_3+...+G_N*S_K)		Interaction: changing **sex** changes the **y ~ group** parameters. Note: $G_{2\text{ to }N}$ is an [indicator (0 or 1)] for each of N levels of the **group** variable except for the one modeled by the intercept (1). Similarly for $S_{2\text{ to }K}$ for **sex**. Line 1 is main effect of **group**, line 2 for **sex** and line 3 is the **group X sex** interaction. For two levels (e.g. male/female sex), line 2 would just be "S_2" and line 3 would be interactions between just S_2 and all $G_{2\text{ to }N}$.	[Coming]
	Counts ~ discrete x N: Chi-square test	M: chisq.test(group * sex_table)	**Equivalent log-linear R model** L: glm(y ~ 1 + G_2 + G_3 + ... + G_N + S_2 + S_3+ ... + S_K + G_2*S_2+G_3*S_3+...+G_N*S_K, family=...)[A]		Interaction: changing **sex** changes the **y ~ group** parameters. Run glm using the following arguments: glm(model, family=binomial(link='log')) As linear-model, the Chi-square test is $\log(y_i) = \log(N) + \log(\alpha_i) + \log(\beta_j) + \log(\alpha_i\beta_j)$ where α_i and β_j are proportions. See more info in [the notebook] accompanying this table.	Same as Two-way ANOVA
	N: Goodness of fit	L: chisq.test(y)	L: glm(y ~ 1 + G_2 + G_3 +...+ G_N, ...)[A]		One intercept per **group** (i.e., x) predicts **y**.	1W-ANOVA

List of parametric (P) non-parametric (N) tests and equivalent linear models. The notation y ~ 1 + x is R shorthand for y = 1·b + a·x which most learned in high-school. Models in similar colors are highly similar. Notice how little changes from line to line! For non-parametric models, the linear models are acceptable approximations for sample sizes in the "if N" column (empty = exact). Click links to see more details. Other less accurate approximations exist, e.g., Wilcoxon for sign test and Goodness-of-fit for binomial test. Some R commands require wide format data (W) with multiple values per row while others require long format (L) with one value per row. The signed rank function is `signed_rank = function(x) sign(x) * rank(abs(x))`. *The variables G_i and S_i are [“dummy coded” indocator variables] (either 0 or 1) exploiting the fact that when Δx=1 between categories the difference equals the slope. Subscripts (e.g., G_2 or y_1) indicate different columns in data.*

[A] *See the note to the two-way ANOVA for explanation of the notation.*
[B] *Same model, but with one variance per group:* `gls(value ~ 1 + G2, weights = varIdent(form = ~1|group), method="ML")`.

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