| | Independent T-Test | Paired T-Test | Correlation | Regression | Multiple Regression | One-Way Between Subjects ANOVA | One-Way Repeated Measures ANOVA | Factorial ANOVA |
|---|---|---|---|---|---|---|---|---|
| **Purpose** | Compare means of 2 independent groups | Compare means of 2 related conditions | Measure strength & direction of relationship | Predict DV from 1 IV | Predict DV from multiple IVs | Compare means of 3+ independent groups | Compare means of 3+ related conditions | Compare means across multiple IVs and test interactions |
| **Variables** | 1 categorical IV (2 levels), 1 numerical DV | 1 categorical IV (2 related levels), 1 numerical DV | 2 numerical variables | 1 numerical IV, 1 numerical DV | Multiple numerical IVs, 1 numerical DV | 1 categorical IV (3+ levels), 1 numerical DV | 1 categorical IV (3+ related levels), 1 numerical DV | 2+ categorical IVs, 1 numerical DV |
| **Assumptions** | Independence, Normality, Homogeneity of Variance | Independent pairs, Normality | Linearity, Normality, Independence | Linearity, Independence, Homoscedasticity, Normality of residuals | Linearity, Independence, Homoscedasticity, Normality of residuals, No multicollinearity | Independence, Normality of residuals, Homoscedasticity | Independence, Normality of residuals, Homoscedasticity, Sphericity | Independence, Normality of residuals, Homoscedasticity |
| **STATA Command** | `ttest DV, by(IV)` | `ttest var1 == var2` | `pwcorr IV DV, sig obs` | `regress DV IV, beta` | `regress DV IV1 IV2 IV3, beta` | `anova DV IVestat esize` | `anova DV IV ID, repeated(IV)estat esize` | `anova DV IV1##IV2estat esize` |
| **Effect Size** | Cohen's d | Cohen's d | Pearson's r | $R^2$ | $R^2$ | $\eta^2$ | $\eta^2$ | $\eta^2$, Partial $\eta^2$ |
| **df** | $n - 1$ | $n - 1$ | $n - 2$ | Model = k<br>Residual = $n - k - 1$<br>Total = $n - 1$ | Model = k<br>Residual = $n - k - 1$<br>Total = $n - 1$ | $k - 1$ | $n - k$ | Depends on factor |
| **Corrections / Follow-ups** | — | — | — | — | — | Bonferroni (planned)Tukey (post-hoc)Welch/Brown-Forsythe | Greenhouse-Geisser ($\varepsilon < .75$)Huynh-Feldt ($\varepsilon > .75$) | Bonferroni (planned)Tukey (post-hoc) |
| **Non-parametric** | Mann-Whitney U `ranksum DV, by(IV)` | Wilcoxon Signed Rank `signrank var1 = var2` | Spearman's rho `spearman var1 var2` | — | — | Kruskal-Wallis `kwallis DV, by(IV)dunntest DV, by(IV) ma(bonferroni)` | Friedman Test | — |

## Assumption Tests

| Assumption | Test | Stata Command | What You're Looking For |
|---|---|---|---|
| Normality | Shapiro-Wilk | `swilk residuals` | p > .05 |
| Normality | P-P Plot | `pnorm residuals` | Points follow line |
| Homogeneity of Variance | Brown-Forsythe | `robvar DV, by(IV)` | W50 p > .05 |
| Homoscedasticity | Residual Plot | `rvfplot, yline(0)` | Random scatter |
| Multicollinearity | VIF | `estat vif` | VIF < 10 |
| Linearity | Scatterplot | `scatter DV IV` | Linear pattern |
| Sphericity | Difference Scores SDs | `su diff1 diff2 diff3` | Similar SDs |
| Compound Symmetry | Correlations Between Conditions | `pwcorr reliance1 reliance2 reliance3` | Similar correlations |
| Compound Symmetry | Lawley's Test | `mvtest correlations reliance1 reliance2 reliance3` | Non-significant = met |

## Graphs

| Graph / Output | STATA Command |
|---|---|
| Histogram + Normal Curve | `histogram residuals, normal` |
| Normal Probability Plot | `pnorm residuals` |
| Scatterplot | `scatter DV IV` |
| Residual vs Fitted Plot | `rvfplot, yline(0)` |
| CI Bar Graph | `cibar DV, over(IV)` |
| CI Plot | `ciplot DV, by(IV)` |
| Marginal Means Plot | `marginsplot` |
| Correlation Matrix | `pwcorr var1 var2, sig obs` |
| VIF Table | `estat vif` |
| Contrast Table | `contrast ...` |
| Pairwise Comparison Table | `pwcompare ...` |

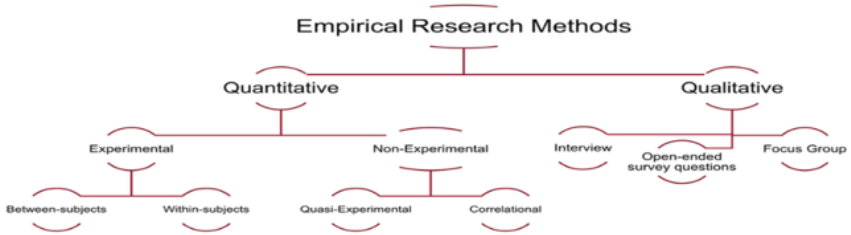
## Effect Sizes

| Test | Effect Size | Formula | What It Means |
|---|---|---|---|
| Correlation | **r** | Given directly | Strength & direction of relationship |
| Correlation | **r²** | $r^2$ | Proportion of variance explained |
| Simple Regression | **R²** | $SS_{Model}/SS_{Total}$ | Variance explained by predictor |
| Multiple Regression | **R²** | $SS_{Model}/SS_{Total}$ | Variance explained by all predictors |
| Independent t-test | **Cohen's d** | Usually provided by `estat esize` | Standardised mean difference |
| Paired t-test | **Cohen's d** | Usually provided by `estat esize` | Standardised mean difference |
| One-Way ANOVA | **η²** | $SS_{Effect}/SS_{Total}$ | Proportion of variance explained |
| Repeated Measures ANOVA | **η²** | $SS_{Effect}/SS_{Total}$ | Proportion of variance explained |
| Factorial ANOVA | **Partial η²** | $SS_{Effect}/(SS_{Effect} + SS_{Error})$ | Effect size for a specific factor |
| Factorial ANOVA Interaction | **Partial η²** | $SS_{Interaction}/(SS_{Interaction} + SS_{Error})$ | Effect size for interaction |

| Analysis and its component | | Effect size | negligible | weak/small | moderate/medium | strong/large |
|---|---|---|---|---|---|---|
| Correlation | | Correlation coefficient r | < .1 | .1 - .29 | .3 - .49 | .5 - 1 |
| Regression | Model-as-a-whole | R-squared | < 2% | 2% - 12% | 13% - 25% | 26% - 100% |
| Regression | Predictor | Standardised beta | < .1 | .1 - .29 | .3 - .49 | .5 - 1 |
| ANOVA | Omnibus effect | Eta-squared or partial eta-squared | < .01 | .01 - .059 | .06 - .14 | .14 - 1 |
| ANOVA | Contrast | Cohen's d | < 0.2 | 0.2 - 0.49 | 0.5 - 0.8 | > 0.8 |

## Degrees of Freedom

| Test | df to Report |
|---|---|
| t-test | t(df) |
| Correlation | r(df = n-2) |
| Regression | F(df_model, df_residual) |
| ANOVA | F(df_between, df_within) |



## Interpreting Outputs

| Test / Output | Common Wording / Clues | What You Can Conclude | Common Trap |
|---|---|---|---|
| **Correlation** | "Relationship", "Association", "Related to", "Linked to" | Variables are associated | Correlation ≠ causation |
| **Regression** | "Predicts", "Unique contribution", "Controlling for", "Best predictor" | Predictor uniquely predicts DV | Significant model ≠ all predictors significant |
| **Significant β** | "After controlling for..." | Unique predictor | Not causation |
| **Independent t-test** | "Difference between two groups" | Groups differ | Means differ ≠ significant |
| **Paired t-test** | "Before vs after", "Pre-post", "Same participants" | Scores changed | Mean change ≠ significant |
| **One-Way ANOVA** | "Three or more groups", "At least one group differs" | At least one group differs | Doesn't tell which groups |
| **Post Hoc** | "Which groups differ?" | Identifies specific groups | ANOVA alone can't do this |
| **Factorial Main Effect** | "Overall", "Across all participants", "Regardless of..." | Overall effect of IV | Doesn't address interaction |
| **Interaction** | "Depends on", "Different for", "Varies according to", "Moderates" | Effect of one IV depends on another | Doesn't tell where |
| **Simple Effect** | "Among women", "Within CBT", "At Time 1", "For males only" | Effect at a specific level | Not a main effect |
| **Repeated Measures** | "Across time", "Across conditions", "Same participants" | Scores differ over time/conditions | Doesn't tell which times differ |
| **Contrast** | "Specifically compare", "Planned comparison", "Hypothesis test" | Specific hypothesis supported | Doesn't mean all groups differ |
| **Margins Table** | "Cell means", "Predicted means", "Margins" | Descriptive pattern only | Not significance |
| **Graph** | Lines, bars, plotted means | Direction/pattern | Not significance |
| **TIME@STRATEGY** | A@B format | Time effect within each strategy | Not strategy effect |
| **STRATEGY@TIME** | A@B format | Strategy effect within each time | Not time effect |

## Recognising Outputs

| If You See... | It's Probably... |
|---|---|
| r and p | Correlation |
| β coefficients | Regression |
| F and p with one IV | ANOVA |
| Multiple Fs for IV1, IV2, IV1×IV2 | Factorial ANOVA |
| Interaction term (`gender#therapy`) | Factorial ANOVA |
| A@B | Simple Effects |
| Margins / Predictive Margins | Descriptive Means |
| Contrast Table | Inferential Follow-Up |
| W50 (robvar) | Homogeneity of Variance |
| VIF | Multicollinearity |
| P-P Plot / pnorm | Normality |
| rvfplot | Homoscedasticity |
| diff1 diff2 diff3 | Sphericity Check |
| Lawley's Test | Compound Symmetry |
| Same participants measured repeatedly | Repeated Measures |

| DATA | Variable 2: categorical | Variable 2: numerical | |
|---|---|---|---|
| Variable 1: categorical | clustered bar charts | comparative box plots | bar charts or pie charts |
| Variable 1: numerical | comparative box plots | scatter plots | histograms |

**Types of validity**
Face validity → does it look like its measuring what it should?
Content validity → coverage
Criterion validity → Is it associated with – converge with – what it should be? – Concurrent vs. predictive & convergent validity)
Discriminant validity → it is *not* associated with – diverge from – what it should?

**TYPE 1 ERRORS**
Reject the null hypothesis when we shouldn't
Concluding "Eureka!" when nothing is going on
When our sample effect is actually due to chance
**TYPE 2 ERRORS**
Not rejecting the null hypothesis when we should
Wiping hands when we should be calling Eureka!
The sample isn't detecting a real population effect

**ETHICS**
**Informed consent**
Participants must know what participation involves, including the risks, before voluntarily consenting to participate in the research
**Limited disclosure**
Elements of the aims and methods of the study are disclosed, however, others are kept hidden
**Deception**
Only, if necessary, but participants must re-consent to the study
**Waiver of consent**
Only justifiable under extreme circumstances

**Types of reliability for measurement tool:**
Test-retest reliability → Same scale to same person at different time points
Internal consistency → How consistent are peoples scores between different items
Alternate form reliability → Different versions of test, consistent in measuring same thing
Inter-rater reliability → People evaluating performance, construct, same assessment

**Sample statistics** → estimates population parameters // Population parameters = Population value, things we know about the data or hypothesis to be true & **Sample statistics** = Sample value, the things we calculate from the data
- To test the hypothesis that a mean is = population value, we assume the sampling distribution of the mean is normal

**Criteria for cause and effect**
**Covariance rule:** There must be a relationship
**Temporal precedence:** The cause must precede the effect. The cause must come before the effect → longitudinal vs cross-sectional can determine this
**Internal validity:** Excluding other potential causes of the effect
External validity: High degrees of external validity mean that the findings of a study can be more easily generalised to the outside world. The more applicable a study is to the outside world, the less control there is over variables within the study, and any findings have an increased likelihood of being explained by outside factors.

All the analyses we covered in this unit