Stats Summary Sheets

Types of Variables – Nominal/Categorical – no order to categories
Ordinal – inherent order but difference between them may not be the same
Interval – continuous

Normal (68% ± 1SD, 95% ± 2SD, 99% ± 3SD) **vs Skewed Distribution**
Normal distribution – use parametric method, and express **mean ± SD**
Non-normal -use nonparametric method, can express median with interquartile range
Mean (average)**, Mode** (most common value)**, Median** (value of middle observation)
Standard error = **standard deviation/square root of n**

Null Hypothesis – No relationship between exposure and disease
Type 1 error – finding a difference when one doesn't exist, incorrectly rejecting the null hypothesis. Refers to α which is typically set at 0.05.
Type 2 error – not finding a difference when one exists (ex. small studies with few patients are "underpowered"). Refers to β which is set at either 0.10 or 0.20.
Power = 1 - β, so the power would be either 90% or 80% to detect a difference if it exists.

Which statistical test to use:
Continuous Variables (ex. length of stay, weight, blood pressure, age)

	Normal Distribution or **Parametric**	Non-normal Distribution or **Nonparametric** or Skewed
Two Independent Samples	t-test (Student's t-test)	Mann Whitney U = Wilcoxon Rank Sum Test
Paired Samples	Paired t-test	Wilcoxon Signed Rank Test for Paired Samples
≥3 Independent Samples	ANOVA	Kruskal-Wallis

Categorical Variables (ex. race, hair color, gender

	Test
Every cell has greater than 5 subjects	Chi square test
Any cell has 5 or less subjects	Fisher's Exact Test
Not independent (measured before & after)	McNemar's Test

Regression = statistical technique where there is one measured **dependent** variable and one or more measured **independent** variables (multivariate). The independent variables can be continuous, dichotomous or categorical.
Linear regression- dependent variable is continuous
Logistic regression- dependent variable is dichotomous. Logistic regression generates Odds Ratios (OR).

Relative Risk versus Odds Ratio
Relative risk or risk ratio compares the probability of disease in each group. It is a ratio of two probabilities. Used in prospective cohort studies, randomized controlled trials

Odds is always a ratio (probability of event happening/probability of event not happening) so an odds ratio is a ratio of two ratios. Used in case control studies (retrospective), outcome is chosen a priori so prevalence is

artificial. As the probability of the event decreases, the odds approximate the probability. Therefore, the OR approximates the RR when the probability of disease is low (around 10%).

Calculating RR and OR

	Outcome +	Outcome -	
Exposure +	a	b	a+b
Exposure -	c	d	c+d

RR = (a/(a+b))/(c/(c+d))
OR= (a/c)/(b/d) = ad/bc

Number Needed to Treat (NNT) is the number of patients who need to be treated in order to prevent one additional "outcome".
NNT = 1/ ARR (attributable or absolute risk reduction)
ARR = risk of outcome in the non-intervention or control group – risk of outcome in intervention group

Survival analysis – Kaplan-Meier Curve – can use **Hazard Ratio**

Multiple Comparisons – can use **Bonferroni adjustment**

Measures of Diagnostic Tests

	Disease +	Disease -	Totals
Test +	TP (a)	FP (b)	a+b
Test -	FN (c)	TN (d)	c+d
	a+c	b+d	a+b+c+d

Sensitivity = a/(a+c) (Proportion of people with dz who have a + test) -want a test for a deadly disease to be as sensitive as possible
Specificity = d/(b+d) (proportion of people w/o dz who have a – test)

Measures of a Diagnostic Test that Consider Prevalence of Disease:
Positive Predictive Value (PPV) = a/(a+b)
Negative Predictive Value (NPV) = d/(c+d)
Positive Likelihood Ratio (LR +) = sensitivity/(1-specificity)
Negative Likelihood Ratio (LR -) = (1- sensitivity)/specificity

Likelihood Ratio: assesses value of diagnostic test, measures change between pre-test probability (prevalence) and post-test probability

Receiver Operating Curve (ROC) – curve at top left is the best screen

Study Design: have the exposure and the outcome
Case Report, Case Series, Case Control Study (start with outcome and see who has exposure), Cohort Study (start with exposure and see who gets outcome)
Clinical trial – Randomized, prospective, double-blinded, placebo-controlled clinical trial is the gold standard to establish causation. Best is intention to treat analysis

Bias – selection, misclassification, recall, reporting, performance, attrition, etc
Ways to avoid – randomization, blinding

Confounding variable – another variable independently associated with both the exposure and the outcome. If you measure the variable you can adjust for it in analysis.
Methods to avoid confounding – randomization, restriction, matching

Effect modification (=interaction) - Association between exposure and outcome varies by the level of a third factor, Different strata. Cannot adjust for it. Just report it.

Prevalence vs Incidence – prevalence is cross-sectional measure vs incidence has time in the denominator (ex. Person-years)

Prevalence = $\frac{\text{Existing cases at a specific time}}{\text{number of people in the total population at that time}}$

Incidence= $\frac{\text{New cases over period of time}}{\text{Number of people at risk for developing disease during that time}}$

Validity – accuracy, how well it measures what it is supposed to
Different types: face, construct, criterion, predictive, content

Reliability – consistency, reproducibility
Different types: Inter-rater, Intra-rater, Test-retest
Internal consistency (Cronbach's alpha – how well sample of items represent domain, 0.7 adequate, 0.8-0.85 good)
Inter-observer reliability – Kappa, needs to be >0.4, prefer between 0.4-0.7

Generalizability (external validity)

Cost-Effectiveness – Quality-Adjusted Life Years (**QALY**)

Forms of Research Misconduct – plagiarism, falsification, fabrication

IRB vs DSMB

Components of **Informed Consent**

Quality Improvement Models: Plan-Do- Study-Act (PDSA) cycles, Six Sigma, Lean

Common cause variation (expected) vs Special cause variation (unexpected)

Run Chart (data over time) vs **Statistical Process Control (SPC) Charts** (more useful, central line is mean, upper and lower control limits ($\pm$ 3SD), shows process changes over time)