PY2103 Statistics Cheat Sheet

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Terminology

Effect Size	Magnitude/Strength of Relationship
Statistical Significance	measures the probability of the null hypothesis being true compared to the acceptable level of uncertainty regarding the true answer. Basically, how likely the finding is attributable to a specific cause and not to chance.
Standard Error	St E = Standard deviation of sampling distribution. Indicates how different a population mean is likely to be from a sample mean
Sampling Error	When the sample does not represent the entire population of data
Confidence Interval	Shows us the probability that a parameter will fall between a pair of values around the mean- basically, shows you the range of values your estimate may fall between if you redo your test within a certain level of confidence
Z score	Is the difference between that individual's score and the mean of the distribution, divided by the standard deviation of the distribution. It represents the number of standard deviations the score is from the mean.
Statistical power	In research design, it means the probability of rejecting the null hypothesis given the sample size and expected relationship strength.
Alpha value	Represents the probability of obtaining your results due to chance. Calculate it by taking 1 - C1 %
Probability value (p value)	likelihood of the observed value of a statistic, if the H0 were true.

Ethics

Ethics	an evolving set of guidelines to assist the researcher in conducting ethical research.
3 areas of research ethics	Relationship between society and science, Professional issues, Treatment of research participants
Relationship between society and science 8 Diener, E., & Crandall, R. (1978). Ethics in social and behavioral research. University of Chicago Press.	About the extent to which societal concerns and cultural values should direct the course of scientific investigation (e.g., government funding, corporate support)
Professional issues	Research misconduct = fabricating, falsifying, or plagiarizing the proposing, performing, reviewing, or reporting of research results
Treatment of research participants	Fundamental issue = treatment of and care for participants
APA Code of Conduct	Beneficence & non-maleficence, Fidelity & responsibility, Integrity, Justice, Respect for people's rights and dignity

Ethics (cont)	
Beneficence and nonmalefi-cience	Beneficence = Acting for the benefit of others Nonmaleficence = Do no harm to others Minimise the risks + maximise the benefits of research
Fidelity and responsibility	Refers to how we interact with others – We need to establish a trusting relationship with research participants. Issues of informed consent/confidentiality/deception
Integrity	We should strive to be honest, accurate, and truthful in all professional activities • Poorly conducted research is unethical. Findings should be reported honestly and disseminated widely
Justice	The benefits and burdens of research should be distributed as fairly as possible. E.g, who receives benefits of new treatment
Respect for people's rights and dignity 21	Respect for the rights and dignity of people. Respect for their autonomy. E.g., right to withdraw, coercion
APA ethics section 8	Institutional approval, Informed Consent, Deception, Debriefing, Coercion/Right to withdraw, Confidentiality/Anonymity/P-rivacy
Institutional Approval	Institutions with active research programs require research to be reviewed by an IRB/HREC
Informed consent	All aspects of research must be disclosed and must be comprehensible to participants 2. Participation should be voluntary, free from coercion; participants must be able to make rational judgement
Informed consent cont	Active versus Passive consent Active = verbally agreeing and signing a form consenting to participate • With children, guardians return forms (failure to return = denying consent) Passive = Consent is indicated by a guardian not returning the form (failure to return = consent). Use active whenever possible.
Deception	Some types of research require deception. Active deception- deliberately misleading participants with false info. Passive deception- withholding info
Coercion, right to withdraw	Coercion = Feeling pressured to participate Right to withdraw = Participants must always feel free to decline participating and/or to stop participating at any time

Ethics (cont)

Privacy, anonymity, confidentiality	Privacy = controlling other people's access to information about a person Anonymity = keeping the identity of a participant unknown Confidentiality = not revealing information obtained from a participant to anyone outside of the research team
Ethics of Animal Research	Concern animal welfare (improving animals' lving conditions and reducing number of animals used in research)but NOT animal rights
Ethics of Animal Research Guidelines	Justification of research, Personnel, Care and housing of animals, Acquisition of animals, Experimental procedures, field research, eduational use of animals
Ethical dilemmas	No determined formula/rule, decision is a subjective judgment
IRB	Institutional Review Board
Ethical issues during authorship commun-ication	Justice (who receives credit for research), Fidelity and scientifc Integrity (accurate and honest reporting)
Steps to adhere to ethical consid-erations	Making changes to your research design, prescreening to identify and eliminate high-risk participants, and providing partic-ipants with as much information as possible during informed consent and debriefing. You need to monitor participants' reactions, be alert for potential violations of confidentiality, and maintain scholarly integrity through the publication process.

Characteristics (C) / Assumptions (A) of Research

Control (C)	Holding constant or eliminating extraneous variables to establish cause-and-effect relationships.
Operationalism (C)	Defining scientific concepts by the specific operations used to measure them. This includes multiple operationalism, where constructs are represented by multiple measures.
Replication (C)	The reproduction of results from one study in additional studies to verify findings.
Uniformity or Regularity in Nature (A)	The assumption that there are consistent and lawful relationships in nature.
Reality in Nature (A)	The belief that the phenomena studied by scientists are real and observable.

Characteristics (C) / Assumptions (A) of Research (cont)

Discoverability (A)	The assumption that these regularities and realities can be discovered through scientific investigation.

Research Approaches

Research Settings	Field Experiments, Laboratory Experiments, Internet Epxeriments
Field experiments (RS)	Artificiliaty not a problem, but cannot control extraneous variables like in a lab
Laboratory experiments (RS)	Ability to control extranueous variables, but introduce artificiality and poor ecological validity
Internet experiments (RS)	Easy access, large samples and low cost, but lack of experimenter control, self-selection, drop out and multiple participant submissions
Descriptive Research (T)	Observing, recording and describing behaviour
Relational/Predictive Research (T)	Describing and detecting/predicting relationships
Causal Research (T)	Describing behaviour, predicting relationships AND exploring cause-and-effect
Qualitative Research (A)	Non-numerical, interpretive approach. Assumes a dynamic, negotiated soccialy consttructed reality. Data is written or spoken words, observationws of behaviour, pictorial or visual matter. Data analysis is thematic analysis with focus on subjective/personal meaning
Quantiative Research (A)	Numerical data. Though sophisticated non-experimental approaches attempt to identify causal relationships • Can help identify factors/relationships to then form hypotheses to be tested with experimental research

Research Approaches (cont)		
Mixed Methods (A)	Mixes Quantitative and Qualitative Research for more complete account	
Quantiative Experimental	Before making causal claim, three criteria: Co-variation (changes must be correlated), Temporal ordering (cause must precede effect), no Alternate Explanations	
Between-subjects design	Different participants exposed to each level of IV	
Within-subjects design	All participants exposed to all levels of the IV. Can mitigate confounding participant variables, which helps better establish cause-and-effect Best used with proper counterbalancing. Also subject to carryover effects.	
Ads/Disads of Experimental Research	Causal inference, ability to manipulate variables, control	Does not test effects of extraneous variables, artificiality, inadequate method of scientific inquiry
Quantitative Non-experimental	No manipulation of the IV, descriptive research, identifies factors/relationships to form hypotheses to then be tested through experimental	
Types of Quan Non-Experimental	Correlational study, Natural manipulation, cross-sectional and longitudinal	
Ads/Dis-Ads of Each Type	Research objectives of description and prediction, Research objectives of description and prediction, Multiple Groups/Time points to consider	Sometimes false assumption of causation, false assumption of causation, cross-sectional/longitudinal do not always produce similar results
Strenghts/Weaknesses of Qualitative Research	Many different data collection methods, good for describing/understanding, provides data to develop theory	Difficult to Generalise, varying interpretations, objective hypothesis testing procedures not always used

Research Approaches (cont)	
Directional/-One-tailed Hypothesis	Group A would have a higher mean on X than Group B. OR. There would be a positive/negative relationship between X and Y.
Non-Directional/ Two-tailed Hypothesis	Groups A and B would differ on X. OR there would be a relationship between X and Y.
Null Hypothesis.	A statement of no relationship among variables, or no differences between conditions.
Content Validity	Ensures the test covers the full range of the concept being measured.
Construct Validity	Measures how well the test reflects the theoretical concept it is designed to assess.
Criterion-Related Validity:	Evaluates how well the test predicts outcomes based on another measure.
Face Validity	Assesses whether the test appears to measure what it is supposed to measure based on subjective judgment
External Validity	Examines if the study's results can be generalized to other settings, people, times, and measures.
Internal Validity	Ensures the study accurately measures the relationship between variables without interference from other factors.
Outcome Validity	Refers to how well a test or measure predicts or correlates with an outcome or behavior that it is supposed to influence or relate to in the real world. It's closely related to predictive validity but focuses on the practical implications of the test's results in real-world outcomes.

Research Approaches (cont)	
P-Value	The p-value is a measure of the probability of obtaining test results at least as extreme as the results actually observed, assuming that the null hypothesis is true. It quantifies the likelihood that the observed data would occur if the null hypothesis were correct. The null hypothesis typically represents a statement of no effect or no difference.
Experimental Research	First feature is that the researchers' manipulation of the independent variable (conditions), and second feature is that the researcher exerts control over variables other than the IV and DV (extraneous variables)
Statistical Validity	Concerns the proper statistical treatment of data and the souwndness of the researchers' statistical conclusions
Non-experimental Research	Research that lacks the manipulation of an IV, but simply involves measuring variables as they naturally occur. Use when the research question relates to a single variable rather than a statistical relationship, or if it's a non-causal statistical relationship, or if the IV cannot be manipulated otherwise
Types of Non-Experimental Research	Correlational Research (measuring two variables with little/no control over extraneous variables), Observational Research (focuses on making observations of behaviour in natural or labs etting without manipulating anything

Research Approaches (cont)

Counterbalancing	Testing different participants in different orders. Best is Complete CB, but random CB can be used when the number of conditions in an experiment is large.
Four Main Types of Validity	are internal validity, external validity, statistical, construct
Concurrent validity	When the criterion is measured at the same time as the construct
Predictive validity	When the criterion is measured at some point in the future (after the construct has been measured)
Convergent validity	Criteria can also include other measures of the same construct
Reliability	The consistency of a measure.
Three types of Consistency	Over time (test-retest reliability), across items (internal consistency), and across different researchers (inter rater reliability).
Statistical significance	Conclusion that an observed finding (e.g., a differencebetween groups or conditions) would be very unlikely if the null hypothesis weretrue.• Practical significance = Clinical significance = Claim made when a statisticallysignificant finding seem large enough to be important.

Relationship between Variables

Statistical Methods to assess if two things are related or not	Correlation, Chi-Square and Regression
Scatterplots	Used to examine relationship between 2 quantitative varaibles. X-axisi: IV. Y-axis: DV.
Pearson's r correlation	Measures degree and direction of linear relationship between quantitative variables. r=0 does NOT necessarily indicate absence of relationship though. Also known as bivariate correlation, and is based on covariance between variables.

Relationship between Variables (cont)

Covariance	How much each variable varies together
Homoscedasticity	Error variance is assumed to be the same at all points along linear relationship
Contingency Table	Used to examine relationship between categorical variables
Pearon's r effect size classifications	r = .10 Small effect • r = .30 Medium effect • r = ≥ .50 Large effect
Correlation coefficient (Pearson's r): Proportion of variance	To calculate the proportion of variance in one variable that can be accounted for by variance in the second, simply square Pearson's r. r2 = .01 Small effect r2 = .09 Medium effect r2 ≥ .25 Large effect

Descriptive Statistics

Descriptive Statistics	Includes Frequency Distribution, Graphic Representations, Central Tendency and Variability
Frequency Distributions	Data arrangement where we show the frequencies of each unique data value
Graphic Representations	Bar Graphs, Histograms, Line Graphs, Scatterplots
Bar Graphs	Vertical bars used to depict frequencies of categorical independent variable (eg both groups)
Histograms	Used to depict frequencies and distribution of quantiative variable. X-axis is the quantiative variable, y-axis is frequency
Line graph	Showing trend of connecting quantiative data. X-axis quantiative, y-axis frequencies .
Line graph can also be used to show interaction effects (e.g., pre-test post-test data)	x-axis is a categorical variable, y-axis is frequencies of each variable
Scatterplot	Graphical Depiction of relationship between 2 quantitative variables. X-axis IV, Y-axis DV.
Central Tendency	Tells us what is typical for a quantiative variable through mean, median and mode
Variability	Tells us how spread out values of a quantiative variable are
Mode	Used best as a representation when data is normally distributed (e.g., symmetrical around mean)
Median	Center point of an ordered set of numbers
Mean	Arithmetic average
3 types of Variability	Range, Variance, Standard Deviation
Range	Highest data score minus lowest data score

Descriptive Statistics (cont)

Variance and Standard Deviation	Superior to range because they take into account ALL of the data values and provide info about dispersion. Variance = the average deviation of data values from their mean in squared units Standard deviation = the square root of the variance

Six Data Collection Methods

Observ-ations	Researcher watches and records events/behaviours. Naturalistic or Laboratory Observations	Provides firsthand information, allows for study of natural behaviour, captures non-verbal cues, usually exploratory/open-ended	Reactive effect if repsondents know they are being observed, invest-igator effects (personal bias), data analysis is time-consuming
Questi-onnaires	Measures participants' opinions and provides self-r-eported demographic info. Closed-ended or open-ended questionnaires	Efficient for large sample, standa-rdised format for easy comparison	Response bias, limited depth of info, potential for misinterpretation
Existing Data	Collection of data that was left behind/used for something different before the current research. Documents, physical data, etc.	cost-effective, time-saving, allows for longitudinal studies	data may be incomplete/outdated, lack of control over data collection methods
Interview	Can be through multiple mediums (face-to-face, phone, etc). Can be synchronous (happens in real-time) or asynchronous (over-time)	Good for measuring attitudes, allows for probing, in-depth info, useful for hypothesis testing	People might not recall important info, reactive effects, investigator effects, expensive and time-conu-sming
Focus Groups	Collection of data in a group situation where moderator leads discussion with a small group	Useful for exploring ideas and concepts, provides window into internal thinking, in-depth info, can be taped	Can be ex, difficult to find good moderator, reactive and investigator effects, measurement validity low
Tests	Data collection instruments designed to measure something. Standardised (existing, tested in previous research) or Researcher-constructed (new, often specifically developed to test for variables)	Provides measures of many characteristics, usually alr developed, availability of data to reference, easy data analysis	Can be ex, reactive participant effects, might not be appropriate for certain samples, open-ended Qs not avail

Inferential Statistics

Inferential Statistics	allows researchers to make generalizations about a population based on sample data. It helps in estimating population parameters and testing hypotheses.

Inferential Statistics (cont)	
Sampling Error	the difference between the sample statistic and the actual population parameter. It is a natural occurrence in sampling and is important to understand for accurate data interpretation.
Sampling Distributions	These are probability distrihutions that can be constructed for any sample statistic
Estimation	This involves using sample data to estimate population parameters. There are two types:
Point Estimation	Provides a single value estimate of a population parameter.
Interval Estimation	Provides a range (confidence interval) within which the parameter is expected to lie.
Confidence Intervals	A confidence interval gives a range of values that is likely to contain the population parameter with a certain level of confidence (e.g., 95%).
Null Hypothesis Significance Testing (NHST)	method for testing a hypothesis by determining the probability of observing the sample data if the null hypothesis is true. It involves setting a significance level (alpha) to decide whether to reject the null hypothesis.
Type I Error	Occurs when the null hypothesis is incorrectly rejected (false positive).
Type II Error:	Occurs when the null hypothesis is not rejected when it is false (false negative).

Sampling	
Sampliing	Can be qualitative or quantitative
Statistics	a numerical characteristic of sample data
Parameter	a numerical characteristic of a population
Sampling error	differences between sample values and the true population parameters. There's always some degree of sampling error. If you need 0 error = you can't sample = conduct a census = collecting data from everyone in the population)
Sampling frame	a list of all the elements in a population
Response rate	the percentage of individuals selected to be in the sample who actually participate in the study
Quantitative Sampling	Can be Random or Non-Random

Sampling (cont)	
Random Sampling	When your goal is to generalize findings to a larger population and you need to minimize bias.Using a random process to select members of the population for inclusion in the sample.All members of the population have an equal chance of inclusion in the sample. Can only be used if we can identify every member of the population.Closely tied to the external validity of research and reduces bias while increasing generalisability and statistical validity. This is representative.
Non-Random Sampling	When studying specific subgroups, when resources are limited, or when the research requires depth over breadthSelecting participants for inclusion in a sample nonrandomly.All members of the population DO NOT have an equal chance of being included in the sample. It is cost-effective and efficient and allows for targetted sampling of a subgroup without a population. This is biased.
Random Sampling Types	Simple Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling
Non-Random Sampling Types	Opportunity/Convenience, Quota, Purposive, Snowball
Simple Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling	Pure mathematical sampling, starting at a random point and then selecting every Nth case, random sampling from homogenous strata of population, random sampling from XX randomly selected clusters
Opportunity/Convenience, Quota, Purposive, Snowball	Selecting individuals based on availability, seeking out a specific numerical number of cases in predetermined categories using non-random methods, using a range of methods to obtain participants with specific characteristics, identifying further cases from elements already in sample
EPSEM	Equal probability selection method (EPSEM). choosing a sample in a manner in which everyone has an equal chance of being selected
Proportional stratified sampling	where the sample proportions are made to be the same as the population proportions. IS an EPSEM
Disproportional stratified sampling	where the sample proportions are made to be different from the population proportions. NOt an EPSEM

Sampling (cont)	
One-stage cluster sampling	randomly select clusters and using all individuals within. E.g., randomly select 15 psychology classrooms using all individuals in each classroom
Two-stage cluster sampling	
Qualitative Sampling	Usually purposive, can include: Maximum variation sampling, Extreme Case Sampling, Homogeneous Sample Selection, Typical-case Sampling, Critical-case Sampling, Negative-case Sampling, Opportunistic Sampling
Random Assignment:	Using a random process to allocate units/elements of the sample to levels of an independent variable.Closely tied to the internal validity of research. Primary use is that it Addresses group-nonequivalence