Statistics

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- Inferential Statistics: for coming to conclusions about what is probably true in a population based on sample values
  - → Uses the laws of probability to provide guidance on what is probably true

- The probability of an event (p) is expressed as a proportion
  - → Eg: the probability of drawing a red card from a normal shuffled deck = $26/52$ = .50

- Probability of Consecutive Events
  - → $P = P(A) \times P(B)$

- Probability and Hypothesis Testing
  - → Null hypothesis (H_0): there's no relationship between the variables you're studying
  - → Alternative hypothesis (H_1): there is a relationship btwn variables
  - → Once probability is less than .05 we reject H_0

- Probability distributions is similar to a histogram & should add up to 1.00

- Probability density function: probability distribution for continuous variables
  - → Population mean = μ → Population SD = σ
  - → $\bar{W}$ continuous variables that are normally distributed the area under the curve can be determined by converting raw scores to z scores

- Sampling Error: sample means from a population tend to fluctuate from one sample to another

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- Sampling distribution: a type of probability distribution that allows us to estimate error
  - → A sampling distribution of the mean is the distribution of an infinite number of sample means from the population
  - → A sampling distribution is a theoretical distribution of values

- Central limit theorem: a mathematic formulation showing that the mean of a sampling distribution of the mean always equals the population mean
  - → If population values are normally distributed so is the sampling distribution of the mean
  - → With large N's, sampling distributions are normally distributed even when population values are not

- The standard error of the mean (SEM) is the standard deviation of a theoretical sampling distribution
  - → the larger the SEM the less likely it is that a sample mean is a good estimate of the population mean.
  - → SEMs are never known but can be estimated
    - → $SEM = SD \div \sqrt{N}$
  - → The larger the sample size, the smaller the SEM, the more accurate the sample mean is likely to be : greater precision in estimates of the population mean

- Statistical Inference Approaches
  - → Two Basic Approaches
    - → Parameter Estimation
    - → Hypothesis Testing

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- Parameter estimation is used to estimate a population value ; eg. a mean, percentage, or odds ratio
  - → Point Estimate : involves the calculation of a single value as the estimate of the parameter
  - → Interval Estimate : provides a range of values within which the population value has a specified probability of lying
    - → Interval estimation involves constructing confidence intervals around the point estimate

- Confidence Interval (95% CI) : designates the range of values within which the parameter has a 95% probability of lying
  - → Constructing a CI involves calculating confidence limits (the upper and lower limit of what is probable)

- Confidence Limits :
  - → The formula for confidence limits around a mean involves three components
    - → The sample mean
    - → The estimated SEM
    - → The value corresponding to the area from a theoretical distribution for the desired CI (eg. 95)
  - → For sample means the appropriate theoretical distribution is the t distribution

- The t distribution is similar to a normal distribution : bell shaped and symmetric
  - → As the sample size increases the t distribution is very close to a normal distribution
  - → For small samples the tail of the t distribution are "fatter"

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- Calculation of CIs

→ 95% CI: M ± (t × SEM)

- Hypothesis Testing uses laws of probability to help researchers make objective decisions about accepting or rejecting a null hypothesis

→ In most cases a null hypothesis states a prediction that variables in the study are not related

→ The research hypothesis (alternative hypothesis) typically states a prediction that variables in the study are related

- Without data from the population, there is always risk of error

- If we decide to reject the null hypothesis & make an error it's a type one error, if we accept the null hypothesis & make an error it's a type two error

- Correct decisions

→ The null hypothesis is really true in the population and the researcher accepts it as true > true negative

→ The null hypothesis is really false in the population, and the researcher rejects it > true positive

- Type One Error: the null hypothesis is really true in the population and the researcher rejects it > false positive

- Type Two Error: the null hypothesis is false in the population but the researcher accepts it > false negative

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- Type I Errors are controlled through the level of significance, the probability accepted as the risk of a false positive
  → the level of significance or alpha (α) is the area in the theoretical probability distribution corresponding to a rejection of the null hypothesis

- The probability of commiting a type II error is called Beta (β)
  → directly related to power ? the power of a statistical test to correctly reject a false null
    → 1 - β
  → Inversely related so higher power means lower risk of type II error
  → β cannot be controlled like α but we can take steps to reduce the risk of β

- Three Factors Influence Power
  → Sample Size → Effect Size → Alpha Level
  → Effect Size: the strength of the relationship btwn independent and dependent variable
  → As you decrease the probability of making a type II error you increase the probability of making a type I error

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- One Sample t test
  - → A statistical test that tests the null hypothesis that the population mean is a specific value
  - → Compares sample mean to a population mean (or hypothesized population mean)
  - → Calculated $t = (M - \mu) \div SEM$
  - → If calculated t is equal to or greater than the table t we reject the null hypothesis
  - → If calculated t is less than table t we retain the null

- Statistical Significance
  - → When the null hypothesis is rejected, the results are statistically significant
  - → If the null hypothesis is retained the results are statistically nonsignificant

- Two-Tailed Statistical Test
  - → Uses both tails of a sampling distribution to determine the critical regions (the region for rejecting the null)

- One-Tailed Statistical Test
  - → Uses only one tail of a sampling distribution in determining the critical region, may be appropriate if the alternative hypothesis is directional
  - → Researchers should have strong evidence for looking at only one tail

- P value equal to or smaller than .05 we reject the null