

Statistics and Research Methods in Psychiatry

Notes for PGY 2/3 Classes

Session 1 - Introduction, Bell Curve, Hypothesis Testing

"Absence of evidence is not evidence of absence."

Basic Concepts

Variable: an abstract entity that can change.

Examples: height, weight, treatment vs. placebo, QIDS at Week 6, ... etc.

Types of Variables: binary, categorical, continuous.

Dependent and Independent Variables

Examples: from the paper

function : representation of relationships between variables.

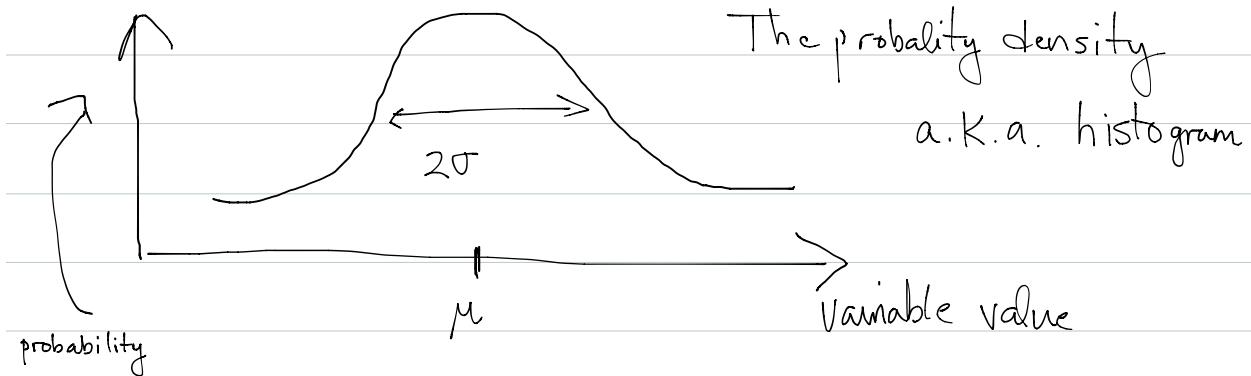
Examples: $Y=f(X)$ What is a function, what isn't a function.

Random Variable : variable whose value is subject to random variation
↓ i.e a pair

Example: [Gender $\in \{\text{male, female}\}$, $P(\text{male})=0.5$]

probability density function

So, random variables are pairs of a variable & its associated pdf.



Examples: from the paper.

Probability distribution = probability density

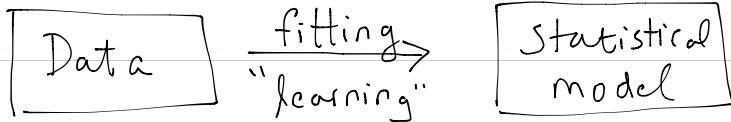
$$P(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Normal distribution = Gaussian
= "the Bell Curve"

Some properties : it's an even function — symmetrical
exponential decay at extreme
adds up to 1

μ = mean σ^2 = variance σ = standard deviation

$1\sigma = 15.7\%$ $2\sigma = 2.1\%$ $3\sigma = 0.1\%$ "2 σ above the mean ~ top 2.1%"



fitting: specification of the precise form of the model

parameters: a number in a model that is modified during fitting

Example: mean, standard deviation, etc.

parametric vs. non-parametric models.

Examples... from the paper.

Statistical Inference: drawing conclusions based on data

Null hypothesis: no relationship between measured phenomena

Examples: from the paper.

P-value: probability of obtaining data that is more extreme than the observed data

Examples: t-test (continuous variables), Chi-square (categorical)

Examples: from the paper

P-values **ALWAYS** depend on sample size. The larger the sample, the smaller the p-value.

Small sample size → larger P-value → "absence of evidence"

Effect size: strength of relationship between variables

$p < 0.05$ — Statistical significance ?? effect size — CLINICAL significance?

Example: paper. Moral: clinical/scientific significance is about effect size and is subject to specific question being addressed.

Discussion pt ① when do we demand high vs. low effect size

Discussion pt ② how do we deal w/ data where clinically sig. evidence is not statistically significant or vice versa.

Effect size in real life. The number needed to treat (NNT)

binary outcome (i.e. remission or NOT), binary treatment (med vs. placebo)

$$NNT = 1 / (\text{Percent med} - \text{Percent placebo})$$

Examples: from the paper... also others from other medical fields.

Confidence Interval: an interval estimate of a value of the parameter (for instance, population average)

Examples: from the paper... Standard confidence intervals are reported in "95% Confidence" which means the estimated quantity is in the interval w/ 95% probability. Confidence Interval shinks

with increasing Sample Size.

Statistical power: the probability that the test will reject the null hypothesis (a.k.a. $1 - \beta$)

Factors influencing power: α -level, effect size,
Sample size.