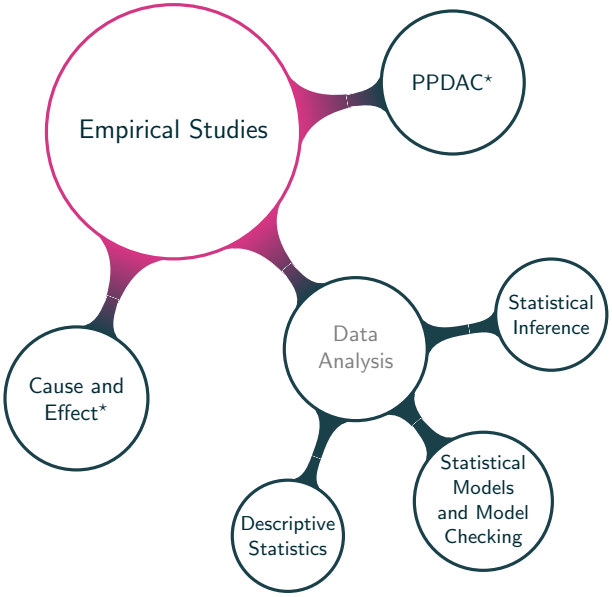
Instructions

For best viewing, download this PDF file to your computer and view as a **single page**.

Click on the words in a bubble to see more detailed information about the topic.

Gray text implies there is no information for that particular item.

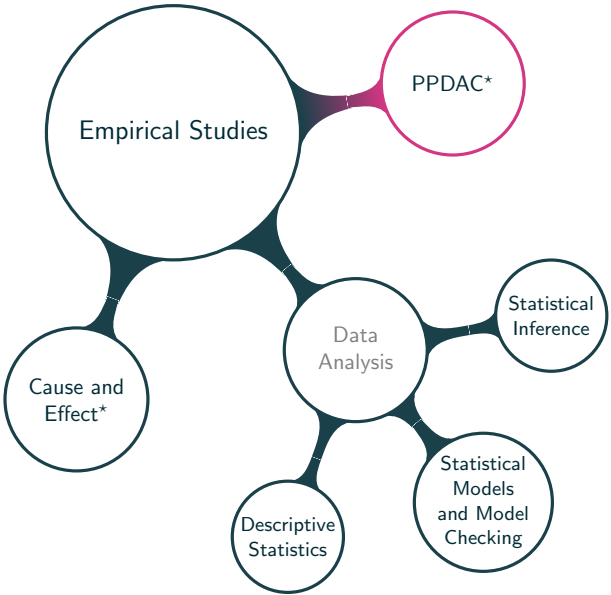
Bubbles marked with a $\star$ are final nodes and have no additional child nodes.



Empirical Studies

- A study is one in which we learn by observation or experiment.
- Populations and processes
- Units, variates, and attributes
- Types of studies

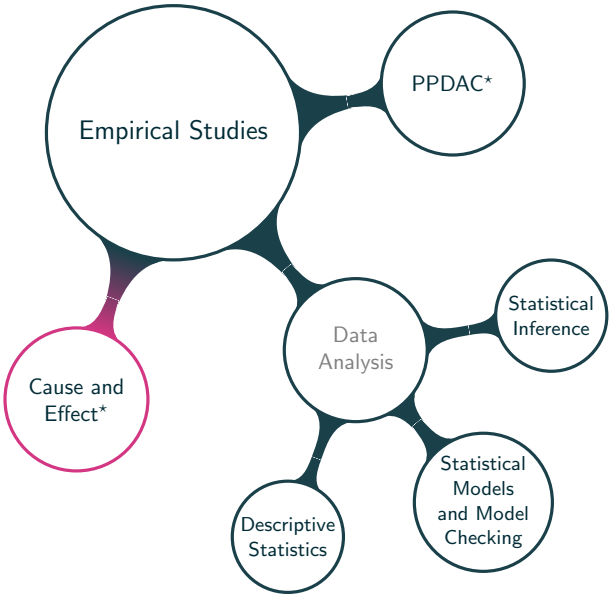
PPDAC



PPDAC

- Steps: Problem, Plan, Data, Analysis, Conclusion
- Types of problems
- Target and study population/processes
- Sample and sampling protocol
- Types of error (study, sample, and measurement)

Cause and Effect

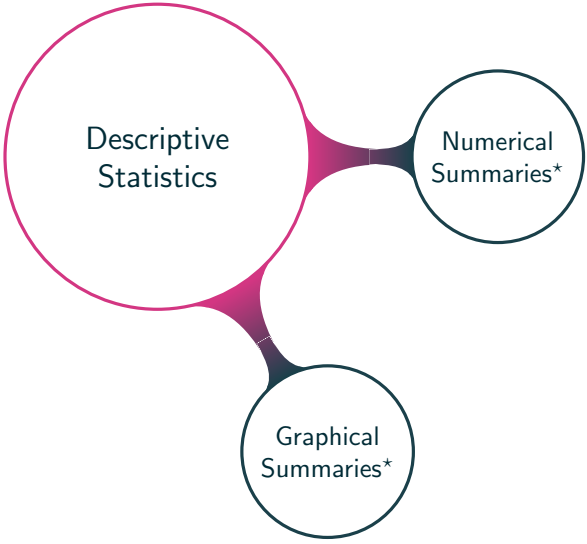


Cause and Effect

- Association does not imply causation
- Importance of experimental studies, controlling variates, and randomization
- Simpson's Paradox

Descriptive Statistics

back to Empirical Studies

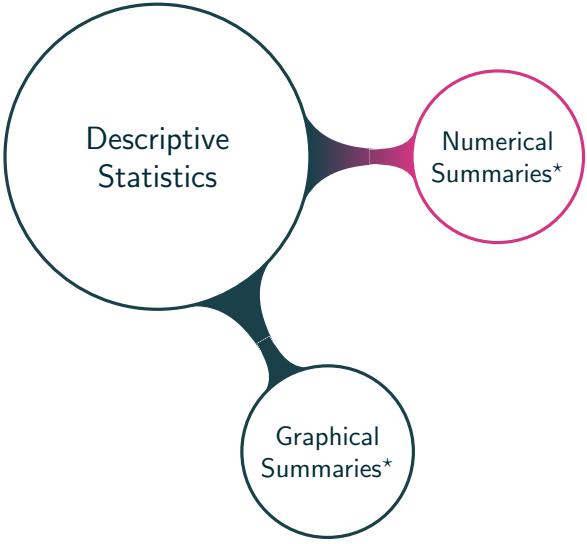


Descriptive Statistics

- Summaries of a data set which illustrate the main features of the data.

Numerical Summaries

back to Empirical Studies

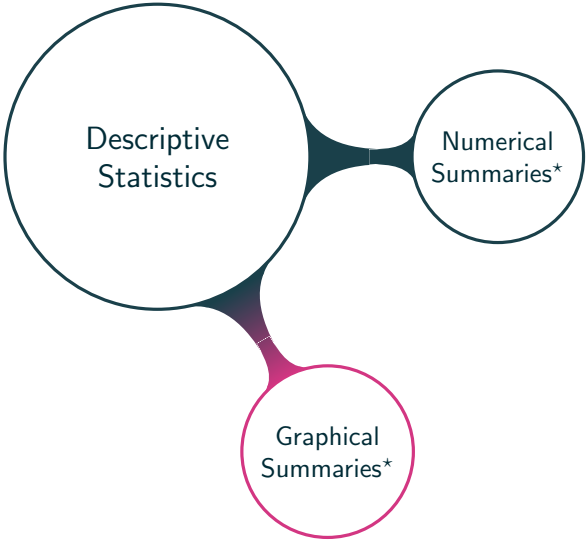


Numerical Summaries

- Measures of location, variability, and shape
- Sample quantiles
- Sample correlation
- Two-way tables
- Relative risk

Graphical Summaries

back to Empirical Studies

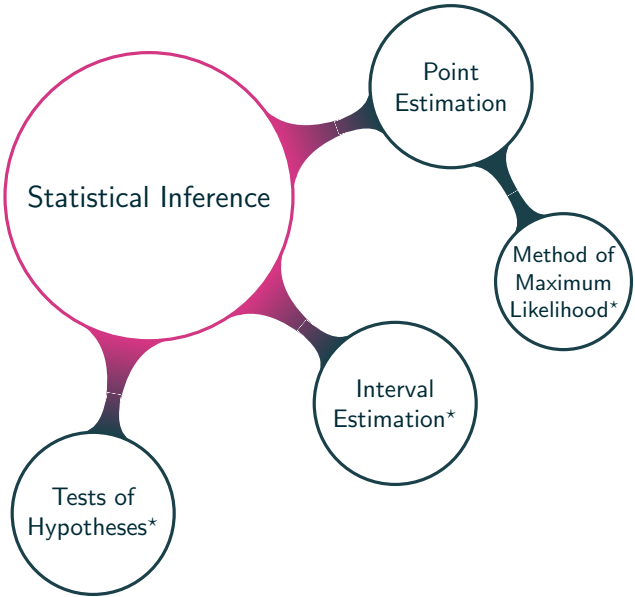


Graphical Summaries

- Histograms
- Empirical cumulative distribution function
- Boxplots
- Qqplots
- Scatterplots

Statistical Inference

back to Empirical Studies

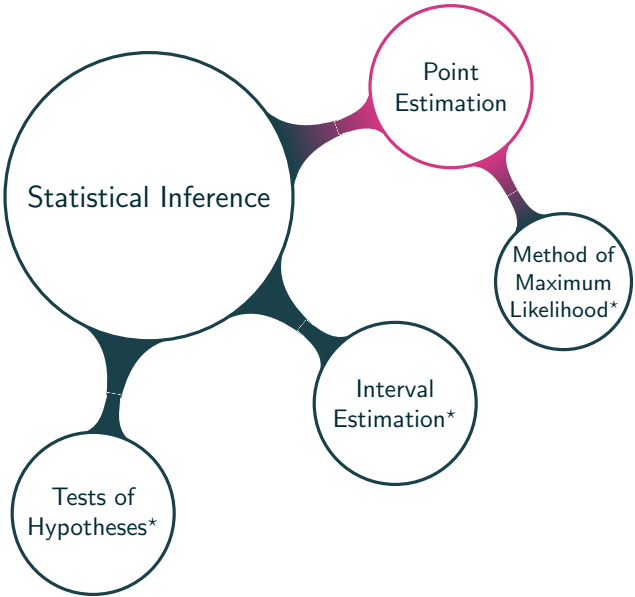


Statistical Inference

- The process of drawing conclusions based on data.

Point Estimation

back to Empirical Studies



Point Estimation

- Point estimates
- Point estimators and sampling distributions
- Sampling distributions
  - χ^2 distribution
  - t distribution

Method of Maximum Likelihood

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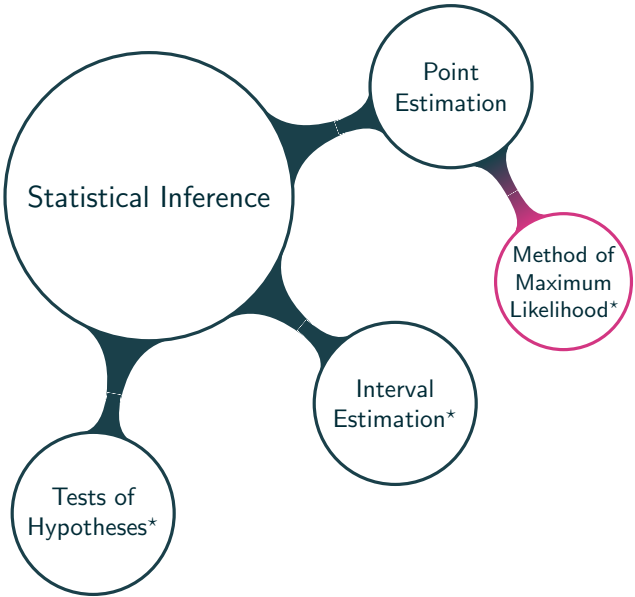

Method of Maximum Likelihood

- Likelihood function
- Maximum likelihood estimate
- Relative likelihood function

Interval Estimation

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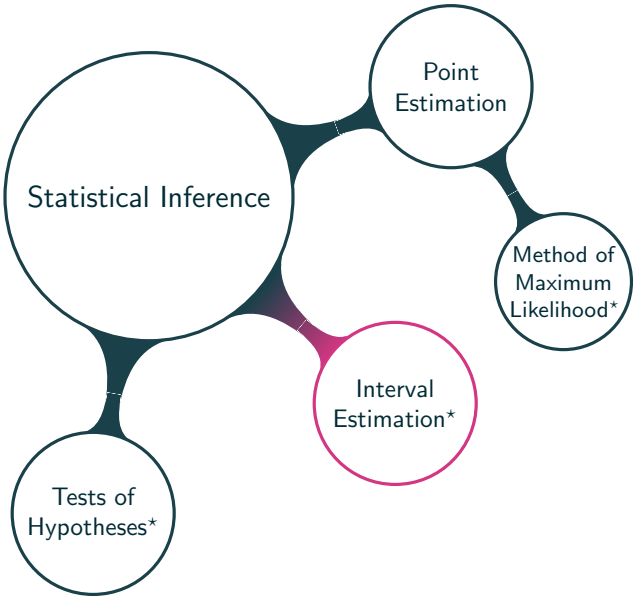

Interval Estimation

- Likelihood intervals
- Likelihood ratio statistic
- Confidence intervals
- Pivotal quantities (exact and approximate)
- Sample size calculation

Tests of Hypotheses

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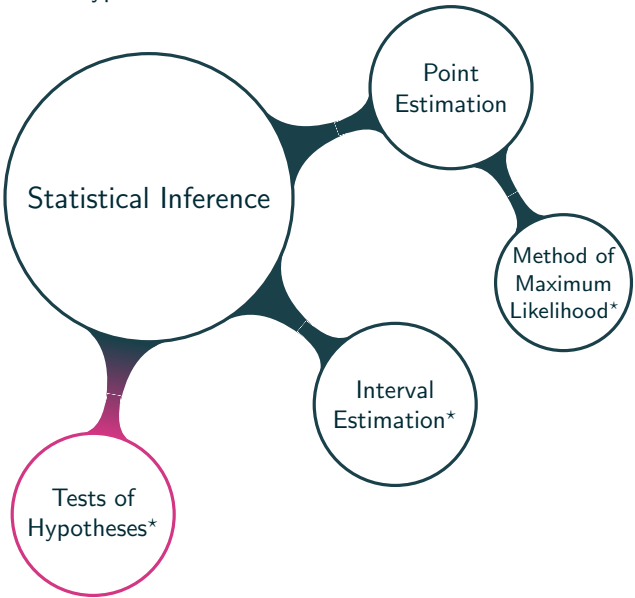
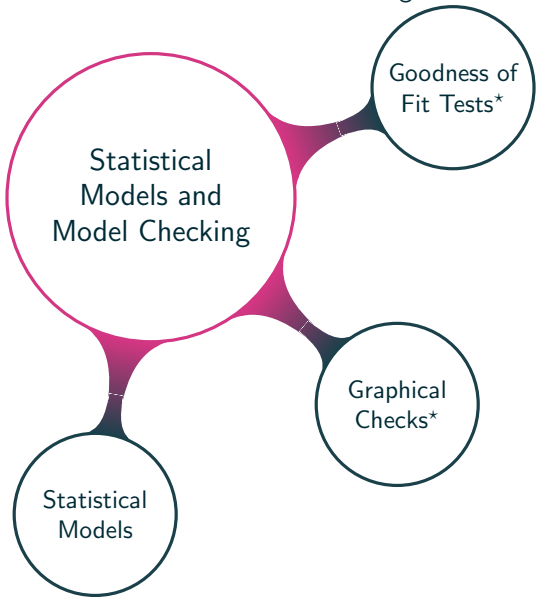


Tests of Hypotheses

- Null and alternative hypotheses
- Test statistic
- p-Value
- Practical versus statistical significance
- Relationship between confidence intervals and test of hypotheses

Statistical Models and Model Checking

back to Empirical Studies

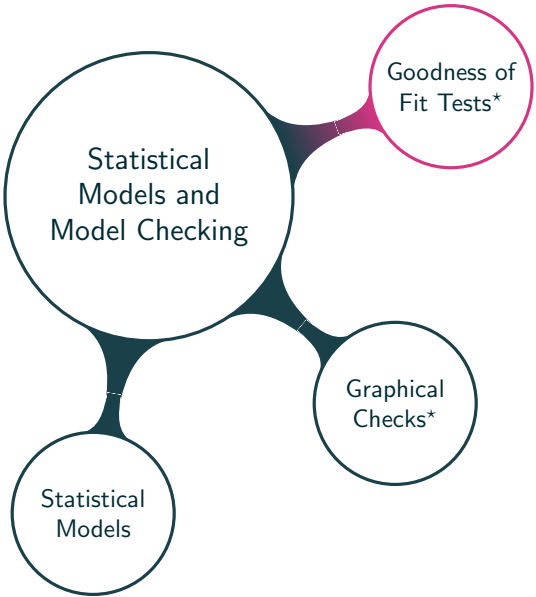


Statistical Models and Model Checking

- Statistical models are used to describe populations and processes.
- Models need to be checked to see how well they describe the population or process.

Goodness of Fit Tests

back to Empirical Studies

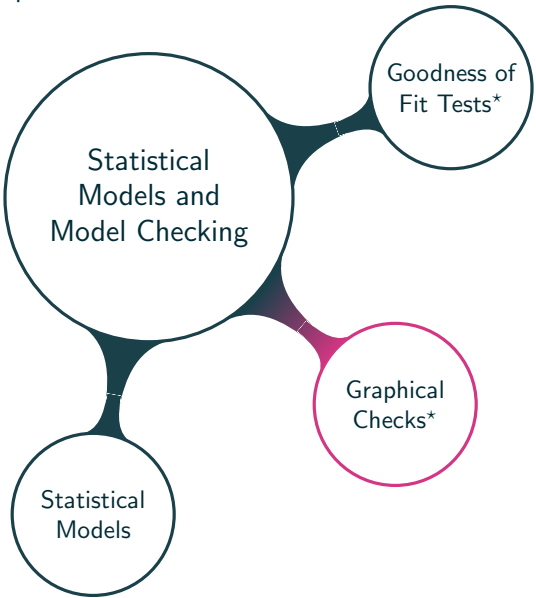


Goodness of Fit Tests

- Multinomial models
- Likelihood ratio goodness of fit test
- Tests for independence in two-way tables

Graphical Checks

back to Empirical Studies

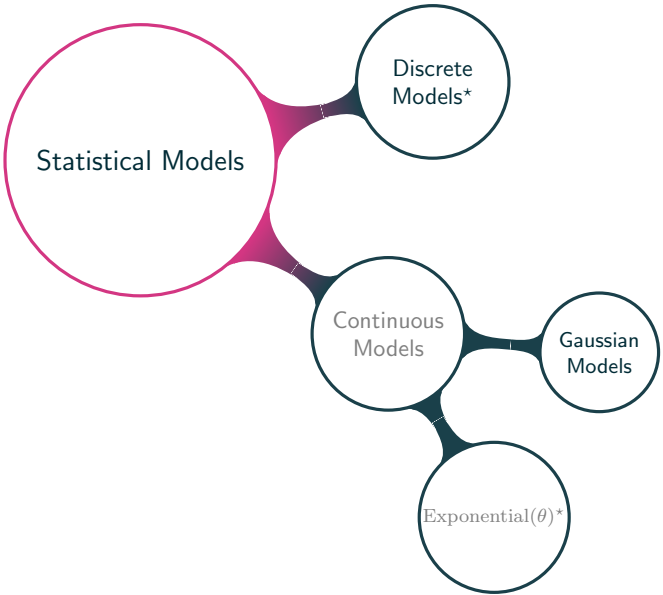


Graphical Checks

- Relative frequency histograms and probability density functions (p.d.f.) for assumed model
- Empirical cumulative distribution functions (c.d.f.) and c.d.f.'s for assumed model
- Qqplots
- Residual plots

Statistical Models

back to Statistical Models and Model Checking

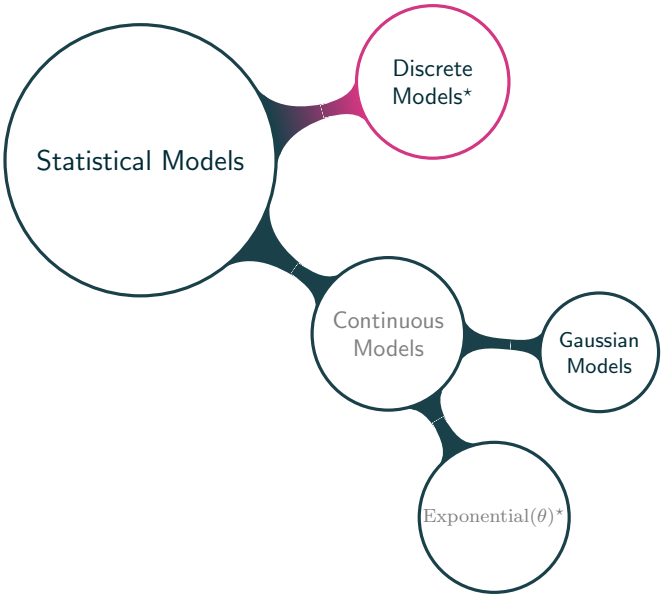


Statistical Models

- Used to describe populations and processes, estimate attributes, and quantify uncertainty.

Discrete Models

back to Statistical Models and Model Checking

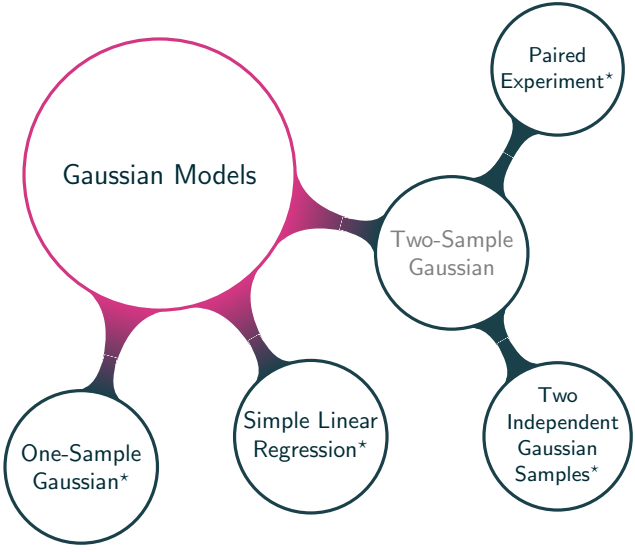


Discrete Models

- Binomial(n, θ)
- Poisson(θ)
- Geometric(θ)
- Negative Binomial(k, θ)
- Multinomial$(n, \theta_1, \theta_2, \ldots \theta_k)$
- Point estimates, interval estimates, and tests of hypotheses for θ

Gaussian Models

back to Statistical Models



Gaussian Models

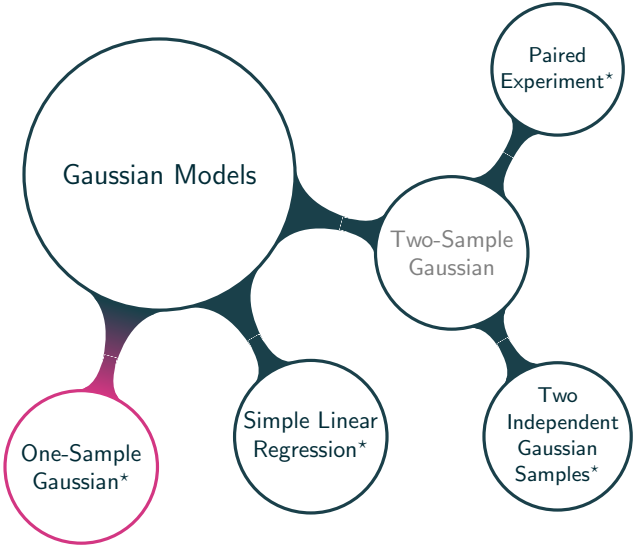
- Models of the form:

$$Y_i \sim G(\mu(x_i), \sigma(x_i))$$

$i = 1, 2, \ldots, n$ independently, where $x_1, x_2, \ldots, x_n$ are known constants

One Sample Gaussian

back to Statistical Models

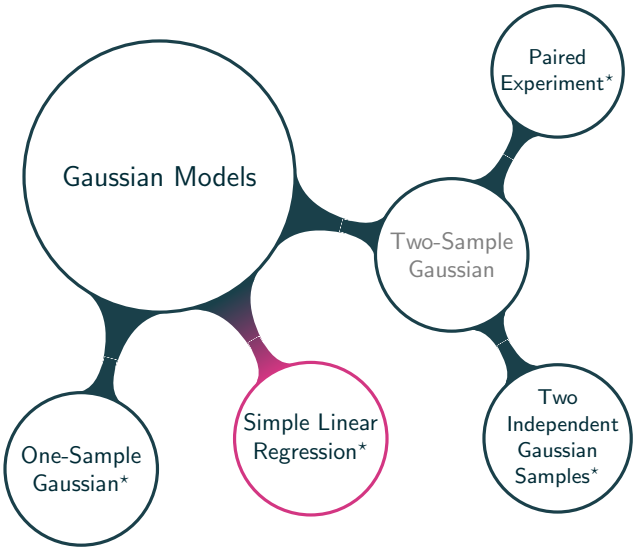


One-Sample Gaussian

- $Y_i \backsim G(\mu, \sigma)$, $i = 1, 2, \ldots, n$ independently
- Qqplots for model checking
- Point estimates, interval estimates, and test of hypotheses for μ and σ

Simple Linear Regression

back to Statistical Models



Simple Linear Regression

- $Y_i \sim G(\alpha + \beta x_i, \sigma)$ $i = 1, 2, \ldots, n$ independently, $x_1, x_2 \ldots, x_n$ known constants
- Residual plots for model checking
- Least squares estimates of α and β
- Hypothesis of no relationship $(H_0 : \beta = 0)$
- Confidence intervals for β and $\mu(x) = \alpha + \beta x$
- Prediction interval for response Y at x

Two Independent Gaussian Samples

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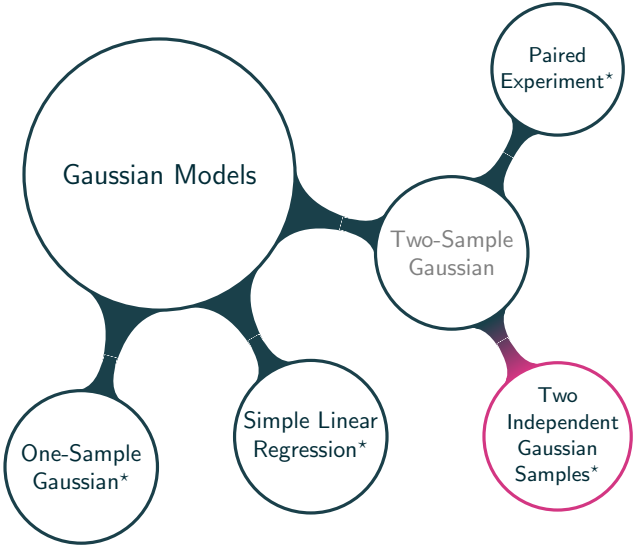
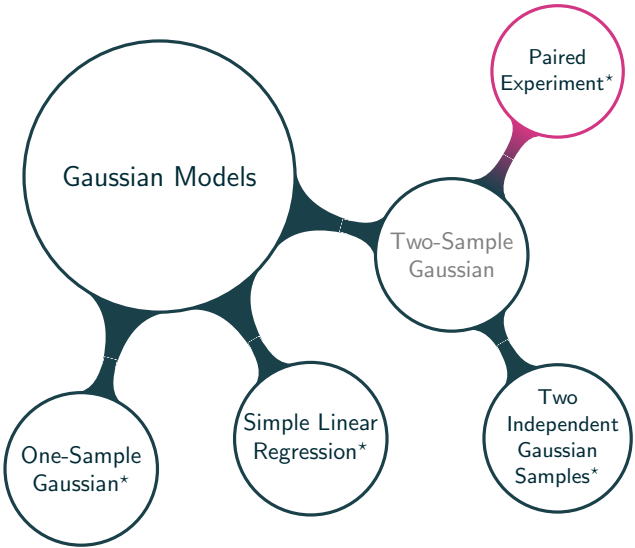


Two Independent Gaussian Samples

- $Y_{1i} \sim G(\mu, \sigma)$, $i = 1, 2, \ldots, n_1$ independently
- $Y_{2i} \sim G(\mu, \sigma)$, $i = 1, 2, \ldots, n_2$ independently
- Qqplots for model checking
- Point estimates of μ_1, μ_2, σ
- Confidence interval for $\mu_1 - \mu_2$:
  - (i) assuming common σ
  - (ii) different σ, but large n_1, n_2
- Test of hypothesis: $H_0 : \mu_1 = \mu_2$
- Confidence interval for common variance σ^2

Paired Experiment

back to Statistical Models



Paired Experiment

- $Y_i = Y_{1i} - Y_{2i} \sim G(\mu, \sigma)$, $i = 1, 2, \ldots, n$ independently ($\mu = \mu_1 - \mu_2$), and analyse as one-sample Gaussian
- Importance of paired experiments