

# Statistics for Business: syllabus

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# 1st lesson: Probability calculus [Background]

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## 1 Annex: Combinatorics

## 2 What is probability?

### 2.1 Laplace rule

### 2.2 Frequency interpretation

### 2.3 Subjective interpretation

## 3 Event algebra

### 3.1 Complementary events

### 3.2 Compatible events

### 3.3 Union

### 3.4 Intersection

### 3.5 Subtraction

### 3.6 De Morgan's laws

### 3.7 Inclusion–exclusion principle

## 4 Multiplication rule

## 5 Law of total probability: tree diagrams

## 6 Bayes theorem

## 7 Introduction to statistical tests

## 2nd lesson: Random variables and probability distributions [Background]

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- 1 Random variables and probability distributions
- 2 Discrete random variables
  - 2.1 Probability function
  - 2.2 Distribution function
- 3 Continuous random variables
  - 3.1 Density function
  - 3.2 Distribution function
- 4 Parameters
- 5 Probability distributions as models
- 6 Correction for continuity

# 3rd lesson: Expected value, variance and other moments [Background]

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## 1 Expected value

### 1.1 Expected value versus arithmetic mean

### 1.2 Properties of the expected value

## 2 Moments

### 2.1 Raw moments

### 2.2 Central moments

## 3 Variance and standard deviation

### 3.1 Properties of the variance

## 4 Expected value and variance as criteria for decision

### 4.1 Log term: expected value

### 4.2 Short term: expected value and risk

### 4.3 Utility function

## 5 Chebysev's inequality

## 4th lesson: Bernoulli processes

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### **1 Bernoulli process: definition**

#### **1.1 Bernoulli distribution**

#### **1.2 Binomial distribution**

##### **1.2.1 Expected value and variance**

##### **1.2.2 Return period**

#### **1.3 Geometric distribution**

#### **1.4 Negative binomial distribution**

## 5th lesson: Hypergeometric distribution

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- 1 Hypergeometric distribution
- 2 Sampling without devolution
- 3 Linking with binomial distribution
- 4 Fisher's exact test

## 6th lesson: Poisson processes

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### 1 Poisson distribution

#### 1.1 Return period

#### 1.2 Poisson approximation of binomial probabilities

### 2 Exponential distribution

#### 2.1 Memorylessness and failure rate

## 7th lesson: Uniform distributions

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### **1 Discrete uniform distribution**

**1.1 Distribution of the maximum**

**1.2 Distribution of the minimum**

**1.3 Sampling in finite populations**

**1.4 German tank problem**

### **2 Continuous uniform distribution**

**2.1 Standard uniform distribution**

**2.2 Distribution of the maximum**

**2.3 Distribution of the minimum**

**2.4 Distribution of the range**



## 8th lesson: Power-law distributions

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- 1 Features
- 2 Detection of power-law distributions
- 3 Continuous distribution: Pareto distribution
- 4 Discrete distribution: Zipf's law

## 9th lesson: Normal distribution and limit theorems

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- 1 Introduction to normal distribution
- 2 Characteristics of the normal distribution
- 3 Properties of the normal distribution
  - 3.1 Linear transformations
  - 3.2 Reproductivity
- 4 Standard normal distribution
- 5 Standardization
- 6 Normal approximation of binomial probabilities: De Moivre-Laplace theorem
- 7 Normal approximation of Poisson probabilities
- 8 Central limit theorem

# 10th lesson: Introduction to statistical inference

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## 1 Statistical inference: scope and basic concepts

## 2 Steps in inference

### 2.1 Sampling

### 2.2 Setting the model: the support

### 2.3 Setting the estimators

### 2.4 Calculating the parameters: estimation and statistical testing

### 2.5 Validation

#### 2.5.1 Randomness tests: runs test

#### 2.5.2 Goodness of fit: chi square test

#### 2.5.3 Homogeneity tests: Wilcoxon rank test

## 11th lesson: Parametric tests

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- 1 Basic methodology**
- 2 Estimators and sampling distributions**
  - 2.1 p-value method**
  - 2.2 Critical region method**
- 3 Tests of proportion**
- 4 Tests of mean**
- 5 Tests of variance**

# 12th lesson: Confidence intervals

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## 1 Point estimation and interval estimation

## 2 t interval for the mean

### 2.1 Construction

### 2.2 Effect of the confidence level

### 2.3 Effect of the sample size

### 2.4 Effect of the standard deviation

### 2.5 Asymmetrical intervals

## 3 Interval for the proportion

### 3.1 Construction

### 3.2 Effects of the confidence level and sample size

### 3.3 Asymmetrical intervals

### 3.4 Sample size calculation

## 13th lesson: Properties of the estimators

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### 1 Unbiasedness

### 2 Precision

### 3 Mean square error

#### 3.1 Uniformly best estimates

#### 3.2 Minimax criterion