### Coordinating unit
200 - FME - School of Mathematics and Statistics

### Teaching unit
715 - EIO - Department of Statistics and Operations Research
1004 - UB - (ENG)Universitat de Barcelona

### Academic year
2019

### Degree
MASTER’S DEGREE IN STATISTICS AND OPERATIONS RESEARCH (Syllabus 2013). (Teaching unit Optional)

### ECTS credits
5

### Teaching languages
English

### Teaching staff

**Coordinator:** ERIK COBO VALERI

**Others:**
- Segon quadrimestre:
  - ERIK COBO VALERI - A
  - ALBERTO COBOS CARBO - A
  - JOSÉ ANTONIO GONZÁLEZ ALASTRUE - A

### Prior skills

The student is expected to have some basic knowledge on descriptive statistics and statistical inference (estimation and testing), including the following: frequency tables and contingency tables; descriptive statistics for continuous variables; histograms, boxplots and scatterplots; interpretation of p-values and confidence intervals, and concepts such as statistic, parameter, and confidence level; one- and two-sided tests, null and alternative hypotheses, significance level, power, and sample size; t-tests on means; classic non-parametric tests for location (Mann-Whitney Wilcoxon rank sum and signed rank tests); z-tests on proportions and independence chi-square test; measures of effect such as difference of means and difference and ratio of proportions.

For example, the student is expected to be able to compute the variance of the difference of 2 random variables; the CI95% and the p-value for the means difference of two normally distributed independent random variables; as well as for the difference of 2 proportions from dichotomic outcomes.

The student is also expected to have some familiarity with a statistical package, preferably R.

- Interpretation of hypotheses and P values within the Fisher evidence framework, as well as the distinction between the hypotheses to be tested and the required assumptions (see http://en.wikipedia.org/wiki/P-value)
- The concepts of alpha, beta, power, Null and Alternative hypotheses within the Neyman-Pearson framework (see http://en.wikipedia.org/wiki/Type_I_and_Type_II_errors)
- The intraclass correlation coefficient (http://en.wikipedia.org/wiki/Intraclass_correlation)
- The concept of collinearity (http://en.wikipedia.org/wiki/Collinearity#Usage_in_statistics_and_econometrics)

### Requirements

Basics of experimental design, inference and R.

---

**University of Barcelona**

200627 - AC - Clinical Trials
**Degree competences to which the subject contributes**

### Specific:

1. CE-1. Ability to design and manage the collection of information and coding, handling, storing and processing it.
2. CE-2. Ability to master the proper terminology in a field that is necessary to apply statistical or operations research models and methods to solve real problems.
3. CE-3. Ability to formulate, analyze and validate models applicable to practical problems. Ability to select the method and / or statistical or operations research technique more appropriate to apply this model to the situation or problem.
4. CE-4. Ability to use different inference procedures to answer questions, identifying the properties of different estimation methods and their advantages and disadvantages, tailored to a specific situation and a specific context.
5. CE-5. Ability to formulate and solve real problems of decision-making in different application areas being able to choose the statistical method and the optimization algorithm more suitable in every occasion. Translate to english
6. CE-6. Ability to use appropriate software to perform the necessary calculations in solving a problem.
7. CE-7. Ability to understand statistical and operations research papers of an advanced level. Know the research procedures for both the production of new knowledge and its transmission.
8. CE-8. Ability to discuss the validity, scope and relevance of these solutions and be able to present and defend their conclusions.

### Transversal:

1. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding how companies are organised and the principles that govern their activity, and being able to understand employment regulations and the relationships between planning, industrial and commercial strategies, quality and profit.
2. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

**Teaching methodology**

The course is highly practical and PBL (project/problems based learning) oriented.

Teacher explanations with slides and seminar activities represents around 60% of face-to-face time. Student presentations (PBL1) of both problems and simulations, and paper reviews, 30%; and active learning activities 10% (PBL2).

Homework guided activities includes solving questionnaires, short data analyses and practical application of guidelines to selected cases.

**Learning objectives of the subject**

After the course, the student will be aware than only a randomized study provides the rationale to confirm and to estimate the effects of an allocated cause. The student will be able to argument and to show that the CT provides a formal basis for evidence in drug and device development; and will apply the rules to provide transparency in reporting.
200627 - AC - Clinical Trials

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 30h (24.00%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h (0.00%)</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 15h (12.00%)</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 0h (0.00%)</td>
</tr>
<tr>
<td></td>
<td>Self study: 80h (64.00%)</td>
</tr>
</tbody>
</table>
# Content

## Background

<table>
<thead>
<tr>
<th>Learning time: 0h 45m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 0h 45m</td>
</tr>
</tbody>
</table>

**Description:**

**Specific objectives:**
The student will read critically an original clinical trial. She/he will analyze and report it in a transparent and reproducible way.

## A1: Analysis of parallel trials without baselines

<table>
<thead>
<tr>
<th>Learning time: 12h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td>Practical classes: 1h 30m</td>
</tr>
<tr>
<td>Self study : 8h</td>
</tr>
</tbody>
</table>

**Description:**
Parallel

## A2: Analysis of parallel trials with baselines

<table>
<thead>
<tr>
<th>Learning time: 12h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td>Practical classes: 1h 30m</td>
</tr>
<tr>
<td>Self study : 8h</td>
</tr>
</tbody>
</table>

**Description:**
Parallel

## A3: Analysis of cross-over trials

<table>
<thead>
<tr>
<th>Learning time: 12h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td>Practical classes: 1h 30m</td>
</tr>
<tr>
<td>Self study : 8h</td>
</tr>
</tbody>
</table>

**Description:**
Statistical analysis, graphic presentation, risk of bias, wording and reporting Baseline measurements. Adjustment, Efficiency. Intra-class correlation.
## A5: CT design, protocol and statistical analysis plan

**Description:**
CT design, protocol and statistical analysis plan

**Learning time:** 12h 30m
- Theory classes: 3h
- Practical classes: 1h 30m
- Self study: 8h

## A5: Regulatory and journal reporting standards

**Description:**
SOPs, EMEA, FDA and ICH documentation, Equator and reporting guidelines

**Learning time:** 12h 30m
- Theory classes: 3h
- Laboratory classes: 1h 30m
- Self study: 8h

## B1: Ethics, Multiplicity

**Description:**
Experiments, medicine and human rights (independence, autonomy, beneficence). Equipoise and original position.
Study objectives. Situations requiring more than one test. Hypothesis and family of hypotheses. Alpha risk control: partial and global.

**Learning time:** 6h 15m
- Theory classes: 1h 30m
- Practical classes: 0h 45m
- Self study: 4h

## B2: Equivalence. Pragmatic trials

**Description:**
Pragmatic versus explanatory trials. Consort extension.

**Learning time:** 6h 15m
- Theory classes: 1h 30m
- Practical classes: 0h 45m
- Self study: 4h
# 200627 - AC - Clinical Trials

<table>
<thead>
<tr>
<th><strong>B3: Sample size rationale.</strong></th>
<th><strong>Learning time:</strong> 12h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 1h 30m</td>
</tr>
<tr>
<td></td>
<td>Self study: 8h</td>
</tr>
</tbody>
</table>

**Description:**
Effect size under the alternative hypothesis. Secondary parameters derived from the assumptions (variance, event and recruitment rates, ...). Methods for continuous, dichotomous and time to event variables.

<table>
<thead>
<tr>
<th><strong>B4: Randomization.</strong></th>
<th><strong>Learning time:</strong> 11h 45m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 0h 45m</td>
</tr>
<tr>
<td></td>
<td>Self study : 8h</td>
</tr>
</tbody>
</table>

**Description:**
Simple, blocks, stratified and adaptive (minimization) randomization.

<table>
<thead>
<tr>
<th><strong>B5: Cluster trials</strong></th>
<th><strong>Learning time:</strong> 6h 15m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 1h 30m</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 0h 45m</td>
</tr>
<tr>
<td></td>
<td>Self study : 4h</td>
</tr>
</tbody>
</table>

**Description:**

<table>
<thead>
<tr>
<th><strong>B6: Sistematic revisions and meta-analysis</strong></th>
<th><strong>Learning time:</strong> 12h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 1h 30m</td>
</tr>
<tr>
<td></td>
<td>Self study : 8h</td>
</tr>
</tbody>
</table>

**Description:**
200627 - AC - Clinical Trials

B7: Adaptative designs

Learning time: 6h 15m
- Theory classes: 1h 30m
- Practical classes: 0h 45m
- Self study: 4h

Description:
Fixed sample designs against adaptive designs. Consumption functions of alpha risk and control. Triangular design. Unbiasedness against shrinkage.

Qualification system

The student mark is the maximum of the final exam and the continuous (C) evaluation.
Mark = Max (F, C)
C is divided in blocks 1 and 2 and each one has 2 parts: Theoretical questions (T, 40%) and Homeworks (H, 60%).
C = 0.2T1+0.3H1+0.2T2+0.3H2
F has 3 parts: Theoretical (T) questions, Exercises (E) and Practices (P), with weights 30%, 40% and 30% respectively:
F = 0.3T+0.4E+0.3P

Bibliography

Basic: