# 310005 - Applied Statistics

**Coordinating unit:** 310 - EPSEB - Barcelona School of Building Construction  
**Teaching unit:** 749 - MAT - Department of Mathematics  
**Academic year:** 2017  
**Degree:** BACHELOR'S DEGREE IN ARCHITECTURAL TECHNOLOGY AND BUILDING CONSTRUCTION (Syllabus 2015). (Teaching unit Compulsory)  
BACHELOR'S DEGREE IN BUILDING CONSTRUCTION SCIENCE AND TECHNOLOGY (Syllabus 2009). (Teaching unit Compulsory)  
**ECTS credits:** 6  
**Teaching languages:** Catalan, Spanish

## Teaching staff

**Coordinator:** CHARA PANTAZI  
**Others:** Ferrer Biosca, Alberto

## Timetable

**Timetable:** To be determined

## Degree competences to which the subject contributes

### Specific:

2. FB-1 Aptitude to use the applied knowledges related with the numerical and infinitesimal calculus, linear algebra, analytic and differential geometry, and the probabilistic and statistical analysis techniques and methods.

### Transversal:

1. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.  
3. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
Learning objectives of the subject

At the end of the course, students should be able to:

- Know how to describe one-dimensional and two-dimensional data groups, and their variability, either in a numerical or graphical form.
- Identify the interrelation between two statistic variables from their correlation.
- Use the regression tools (linear and non-linear) in order to do a prediction.
- Understand the concepts and experiences of randomness.
- Understand the probability concepts and conditional probability.
- Calculate the probability of random events in simple experiences.
- Use the concept of random variable as a description element of the variability of a random experience and its modelling.
- Identify the probability distribution and the expectation and variance parameters of random discrete and continuous variables: Bernoulli, Binomial, Poisson, Uniform, Normal, t-Student, Khi2 Pearson, as well as to calculate the probabilities associated in the aforementioned random variables.
- Understand the need and the concept of estimator of a population parameter, as a random variable, from the obtained information of a sample.
- Distinguish the concepts of bias and estimator consistency.
- Estimate the expected value and the variance of a population from the correspondent sample statistics and for a given confidence level. In particular, to estimate proportions.
- Use hypothesis testing (two-sided and one-sided) for the decision making.
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- Analyse and interpret data using an analytical statistics software (Minitab).

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 15h</td>
<td>10.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 15h</td>
<td>10.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 90h</td>
<td>60.00%</td>
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</table>
### Content

**C1 Review of Random Variables and Descriptive Statistics**

**Learning time:** 60h  
**Theory classes:** 15h  
**Guided activities:** 0h  
**Self study:** 45h

**Description:**  
This content work with the first three themes: Descriptive Statistics Review, Discrete Random Variables (VAD) and Continuous Random Variables (VAC). Specifically,

The Descriptive Statistic Review works:
- Population and associated statistic variables.  
- Uni-dimensional distributions and its representations.  
- Uni-dimensional statistics and its representations.  
- The Theorem or Inequality of Tchebyshhev (for data).  
- The axiomatic theory of probability and derived properties.  
- The tool of the tree diagrams for the representation of the sample space.  
- The concept of conditional probability and the Bayes formula.

The VAD theme works:
- The concept of discrete random variable (r.v.), probability function and associated distribution function.  
- The definition and calculation of the hope and variance of a discrete r.v.  
- The Theorem or Inequality of Tchebyshhev (for r. v. discrete).  
- The Bernoulli, Binomial and Poisson distributions.

The VAC theme works:
- The concept of continuous random variable (r. v.), density function and associated distribution function.  
- The definition of Hope and variance of a continuous r. v.  
- The Theorem or Inequality of Tchebyshhev (for r. v. continuous).  
- The Normal distribution, t-Student y Ji^2.  
- The approximation of the Binomial distribution by the Normal or Poisson.

Each theme works in the resolution of problems associated to the previous concepts, manually and using the software Minitab.

**Related activities:**  
This does the activities of solving guide problems corresponding to each topic of the first content, PG1, PG2 and PG3, the PI1 project activity and the evaluation activities Q1 and L1, in the form of an individual questionnaire in Atenea and the written test PE1 about the content C1.
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<table>
<thead>
<tr>
<th><strong>Statistical Inference and Linear Models</strong></th>
<th><strong>Learning time:</strong> 60h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 15h</td>
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<tr>
<td></td>
<td>Guided activities: 0h</td>
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<tr>
<td></td>
<td>Self study: 45h</td>
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</tbody>
</table>

**Description:**
In this content the last two subjects are worked, Statistical Inference, IE and Linear Models, ML. Specifically,

- The necessity of estimating a population parameter from sample statistics, and its character as a random variable.
- The concepts of bias, consistency and efficiency of an estimator.
- The difference and interpretation of the point estimate and the interval estimation.
- The calculation of confidence intervals for the estimation of means.
- The calculation of confidence intervals for estimation of variance (or standard deviation).
- The calculation of confidence intervals for the estimation of proportions.
- The contrast of hypotheses (bilateral and unilateral) for decision making.
- The goodness of fit test.

In the Linear Models Theme, ML, we work:
- Two-dimensional distributions and their representation.
- The marginal distributions.
- The concepts of covariance, correlation and coefficient of determination.
- The calculation and use for prediction of the regression lines of Y over X and of X over Y.

In both themes, work is done to solve problems associated with the above concepts, manually and using Minitab software.

**Related activities:**
The activities of resolution of problems PG4, PG5 and PG6, the project activity PI2, the evaluation activities Q2 and L2 by individual test in Atenea and PE2 that correspond to the written exam of the content C2.
### Planning of activities

<table>
<thead>
<tr>
<th>A1 CONTENT 1 QUESTIONNAIRE (Q1)</th>
<th>Hours: 8h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 0h 40m</td>
</tr>
<tr>
<td></td>
<td>Self study: 7h 20m</td>
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</tbody>
</table>

**Description:**
Individual questionnaire done in Atenea (in the EPSEB computer classroom), with 8 questions and penalization. The dedication of self-knowledge is an estimation of the time the student may need for the preparation of the exam. This time includes the realization of 9 attempts (3 attempts for each lesson T1, T2 and T3) of simulation of the questionnaire, on the same background, in order to learn and self-evaluate him/her. The 9 self-evaluations will be done in the established time. Its realization is compulsory for the assistance to the official questionnaires.

**Support materials:**
Preparation/study: presentation documents, exercises resolution and evaluation questionnaires. These documents can't be brought to the questionnaire.

**Questionnaire:** Atenea questionnaire

**Descriptions of the assignments due and their relation to the assessment:**
Register of the answers of the student. The corrected resolution is commented by the faculty on the campus. It is a quarter of the content 1 mark, N1.

**Specific objectives:**
The purpose of the questionnaire is to evaluate if the student is able to:
- Describe data groups, unidirectional and bidirectional, and its variable.
- Identify the interrelation between two statistic variables.
- Use regression tools (linear and no linear) to make prediction.
- Understand the concepts of randomness and random experience.
- Understand the concepts of probability and conditional probability.
- Calculate the probabilities of random events and simple events.

<table>
<thead>
<tr>
<th>A3 PUNTUABLE LABORATORY CONTENT 1 (L1)</th>
<th>Hours: 8h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 0h 40m</td>
</tr>
<tr>
<td></td>
<td>Self study: 7h 20m</td>
</tr>
</tbody>
</table>

**Description:**
Individual questionnaire with 8 questions and penalization, about the data analysis done with Minitab software. The questionnaire is done in the computer room of the EPSEB. The data set distributed for the analysis will be similar to the first part of the Integrated Project (PI1). The self-learning dedication indicated is a estimation of the time that the student can need for preparation, basically dedicated to redo the practical lab classes and the fulfilment of the activity PI1.

**Support materials:**
Preparation/study: All the course material for the content 1, specially the execution of Minitab practices. Any of this material can be used during the questionnaire.

**Questionnaire:** Atenea questionnaire with the use of Minitab software.

**Descriptions of the assignments due and their relation to the assessment:**
Register of the answers of the student. The corrected resolution is commented by the faculty on the campus. It is a quarter of the content 1 mark, N1.
Specific objectives:
The purpose of the questionnaire is to evaluate if the student is able to:
- Describe data groups, unidirectional and bidirectional, and its variable.
- Identify the interrelation between two statistic variables.
- Use regression tools (linear and no linear) to make prediction.
- Understand the concepts of randomness and random experience.
- Understand the concepts of probability and conditional probability.
- Calculate the probabilities of random events and simple events.

A2 WRITTEN EXAM OF CONTENT 1 (PE1) | Hours: 11h
---|---
Theory classes: 1h 20m
Self study: 9h 40m

Description:
Written exam consisting of the resolution of problems/questions about the contents block 1. The autonomous self-learning dedication is an estimation of the time that the student can need for the preparation, basically dedicated to the resolution of the exercises disclosed in Atenea and the revision of the guide problems (PG1, PG2 and PG3).

Support materials:
Preparation / Study: All the course material related to the content C1, specially the presentation files, the resolution of examples and exercises. Any of these materials can be used during the exam.
At the exam: Written wording. The student can only use as additional material a scientific calculator.

Descriptions of the assignments due and their relation to the assessment:
Answer sheet of the student corresponding to the written part. The corrected resolution with the corresponding feedback of the faculty is commented on the next session and personally in the office hours. It worths half the mark of the content 1, N1.

Specific objectives:
The purpose of the questionnaire is to evaluate if the student is able to:
- Describe data groups, unidirectional and bidirectional, and its variable.
- Identify the interrelation between two statistic variables.
- Use regression tools (linear and no linear) to make prediction.
- Understand the concepts of randomness and random experience.
- Understand the concepts of probability and conditional probability.
- Calculate the probabilities of random events and simple events.

A4 CONTENT 2 QUESTIONNAIRE (T2) | Hours: 4h 40m
---|---
Theory classes: 0h 40m
Self study: 4h

Description:
Individual questionnaire done in Atenea (in the EPSEB computer classroom), with 8 questions and penalization. The dedication of self-knowledge is an estimation of the time the student may need for the preparation of the exam. This time includes the realization of 9 attempts (3 attempts for each lesson T1, T2 and T3) of simulation of the questionnaire, on the same background, in order to learn and self-evaluate him/her. The 9 self-evaluations will be done in the established time. Its realization is compulsory for the assistance to the second content exams.
### Support materials:
- Preparation/study: All the content 2 material, specially the exposition files, the resolution of exercises and the self-learning tests. None of these materials can be used during the exam.
- Questionnaire: Atenea questionnaire. In case that the student need distribution tables, Minitab tables can be used.

### Descriptions of the assignments due and their relation to the assessment:
- Register of the answers of the student. The corrected resolution is commented by the faculty on the campus. It is a quarter of the content 2 mark, N2.

### Specific objectives:
- The purpose of the questionnaire is to evaluate if the student is able to:
  - Understand the randomness and randomness experience concepts.
  - Understand the probability and conditioned probability concepts.
  - To calculate random events probabilities.
  - Use the random variable concept as an element for the description of the variability in a random experience and its modelling.
  - Identify the probability distribution and the parameters of expectation and variance of these discrete and continous random variables: Bernoulli, Binomial, Poisson, Uniform, Normal, t-Student, Khi^2 Pearson, as well as calculate associated probabilities of these random variables.
  - To understand the necessity and the concept of stimator of a population parameter, as a random variable, from the information obtained by a sample.
  - To distinguish the concepts of bias and consistency of a stimator.
  - To estimate the expectation and the variance of a population from the corresponding statistical samples and for a given confidence level. In particular, to estimate proportions.
  - Use the contrast of hypothesis (unilateral and bilateral) for the decision choice.

### (ENG) A5 WRITTEN EXAM OF CONTENT 2 (P2)

<table>
<thead>
<tr>
<th>Hours: 11h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 1h 20m</td>
</tr>
<tr>
<td>Self study: 9h 40m</td>
</tr>
</tbody>
</table>

### Description:
Written exam consisting of the resolution of problems/questions about the contents block 1. The autonomous self-learning dedication is an estimation of the time that the student can need for the preparation, basically dedicated to the resolution of the exercises disclosed in Atenea and the revision of the guide problems (PG4, PG5 and PG6).

### Support materials:
- Preparation / Study: All the course material related to the content C1, specially the presentation files, the resolution of examples and exercises. Any of these materials can be used during the exam.
- At the exam: Written wording. The student can only use as additional material a scientific calculator.

### Descriptions of the assignments due and their relation to the assessment:
Answer sheet of the student corresponding to the written part. The corrected resolution with the corresponding feedback of the faculty is commentated on the next session and personally in the office hours. It worthwhile half the mark of the content 2, N2.
A6 PUNTUABLE LABORATORY CONTENT 2 (L2)  

Hours: 8h  
Theory classes: 0h 40m  
Self study: 7h 20m

Description:  
Individual questionnaire with 8 questions and penalization, about the data analysis done with Minitab software. The questionnaire is done in the computer room of the EPSEB. The data set distributed for the analysis will be similar to the first part of the Integrated Project (PI2). The self-learning dedication indicated is an estimation of the time that the student can need for preparation, basically dedicated to redo the practical lab classes and the fulfilment of the activity PI2.

Support materials:  
Preparation/study: All the course material for the content 2, specially the execution of Minitab practices. Any of this material can be used during the questionnaire.  
Questionnaire: Atenea questionnaire with the use of Minitab software.

Descriptions of the assignments due and their relation to the assessment:  
Register of the answers of the student. The corrected resolution is commented by the faculty on the campus. It is a quarter of the content 2 mark, N2.

Specific objectives:  
The purpose of the questionnaire is to evaluate if the student is able to:  
- Understand the randomness and randomness experience concepts.  
- Understand the probability and conditioned probability concepts.  
- To calculate random events probabilities.  
- Use the random variable concept as an elemento for the description of the variability in a random experience and its modelling.  
- Identify the probability distribution and the parameters of expectation and variance of these discrete and continuous random variables: Bernoulli, Binomial, Poisson, Uniform, Normal, t-Student, Khi^2 Pearson, as well as calculate associated probabilities of these random variables.  
- To understand the necessity and the concept of stimator of a population parameter, as a random variable, from the information obtained by a sample.  
- To distinguish the concepts of bias and consistency of a stimator.  
- To estimate the expectation and the variance of a population from the corresponding statistical samples and for a given confidence level. In particular, to estimate proportions.  
- Use the contrast of hypothesis (unilateral and bilateral) for the decision choice.
### A10 GUIDE PROBLEM THEME 1, CONTENT 1 (PG11)

**Description:**
Activity done in the problems class, medium group, consisting on the resolution, individually or in group (maximum groups of 4 students), of a guide problem that collect the main practical aspects of the Content 1. The autonomous self-learning dedication is a stimation of the time that the student need afterwards the class for revising and consolidating the specific objectives of the activity.

**Support materials:**
- Preparation / Study: The notes and presentations of the course for the Content 1, particularly the resolution of the examples which have illustrated the introduction of concepts.
- During the activity: The current material and the wording of the guide problem which the professor distribute in the same session.

**Descriptions of the assignments due and their relation to the assessment:**
The exercise is carried out by groups and simultaneously on the blackboard. The students must sign the class attendance, but they don't need to nad over the activity. The activity is not explicitly linked to the evaluation. Even so the student must have a minimum attendance of 50% in these problem sessions and lab classes of the Content C1.

**Specific objectives:**
At the end of the activity, the student should be able to:
- Describe one-dimensional and two-dimensional data set and its variability, in a numerical and a graphical way.
- Identify the interrelation between two statistic variables from the correlation between them.
- Use the regression tools (lineal and non-lineal) for predicting.

<table>
<thead>
<tr>
<th>Hours</th>
<th>Theory classes: 2h</th>
<th>Self study: 2h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours</td>
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</table>

### A11 GUIDE PROBLEM, CONTENT 1 (PG12)

**Description:**
Activity done in the problems class, medium group, consisting on the resolution, individually or in group (maximum groups of 4 students), of a guide problem that collect the main practical aspects of the Content 2. The autonomous self-learning dedication is a stimation of the time that the student need afterwards the class for revising and consolidating the specific objectives of the activity.

**Support materials:**
- Preparation / Study: The notes and presentations of the course for the Content 2, particularly the resolution of the examples which have illustrated the introduction of concepts.
- During the activity: The current material and the wording of the guide problem which the professor distribute in the same session.

**Descriptions of the assignments due and their relation to the assessment:**
The exercise is carried out by groups and simultaneously on the blackboard. The students must sign the class attendance, but they don't need to nad over the activity. The activity is not explicitly linked to the evaluation. Even so the student must have a minimum attendance of 50% in these problem sessions and lab classes of the Content C1.

<table>
<thead>
<tr>
<th>Hours</th>
<th>Theory classes: 2h</th>
<th>Self study: 2h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours</td>
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</tbody>
</table>

**Hours:** 4h
Theory classes: 2h
Self study: 2h
Specific objectives:
At the end of the activity, the student should be able to:
- Describe one-dimensional and two-dimensional data set and its variability, in a numerical and a graphical way.
- Identify the interrelation between two statistic variables from the correlation between them.
- Use the regression tools (linear and non-linear) for predicting.

A12 GUIDE PROBLEM, CONTENT 2 (PG21) Hours: 4h
Theory classes: 2h
Self study: 2h

Description:
Activity done in the problems class, medium group, consisting on the resolution, individually or in group (maximum groups of 4 students), of a guide problem that collect the main practical aspects of the Content 3. The autonomous self-learning dedication is a estimation of the time that the student need afterwards the class for revising and consolidating the specific objectives of the activity.

Support materials:
Preparation / Study: The notes and presentations of the course for the Content 3, particularly the resolution of the examples which have illustrated the introduction of concepts.
During the activity: The current material and the wording of the guide problem which the professor distribute in the same session.

Descriptions of the assignments due and their relation to the assessment:
The exercise is carried out by groups and simultaneously on the blackboard. The students must sign the class attendance, but they don't need to hand over the activity. The activity is not explicitly linked to the evaluation. Even so the student must have a minimum attendance of 50% in these problem sessions and lab classes of the Content C1.

Specific objectives:
At the end of the activity, the student should be able to:
- Understand the concepts of randomness and random experience.
- Understand the concepts of probability and conditional probability.
- Calculate the probabilities of random events and simple events.

A13 GUIDE PROBLEM, CONTENT 2 (PG22) Hours: 4h
Theory classes: 2h
Self study: 2h

Description:
Activity done in the problems class, medium group, consisting on the resolution, individually or in group (maximum groups of 4 students), of a guide problem that collect the main practical aspects of the Content 4. The autonomous self-learning dedication is a estimation of the time that the student need afterwards the class for revising and consolidating the specific objectives of the activity.

Support materials:
Preparation / Study: The notes and presentations of the course for the Content 4, particularly the resolution of the examples which have illustrated the introduction of concepts.
During the activity: The current material and the wording of the guide problem which the professor distribute in the same session.
**Descriptions of the assignments due and their relation to the assessment:**

The exercise is carried out by groups and simultaneously on the blackboard. The students must sign the class attendance, but they don't need to nad over the activity. The activity is not explicitly linked to the evaluation. Even so the student must have a minimum attendance of 50% in these problem sessions and lab classes of the Content C2.

**Specific objectives:**

At the end of the activity, the student should be able to:
- Use the random variable concept as an elemento for the description of the variability in a random experience and its modelling.
- Identify the probability distribution and the parameters of expectation and variance of these discrete and continuous random variables: Bernoulli, Binomial and Poisson as well as calculate associated probabilities of these random variables.

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**Description:**

Activity done in the problems class, medium group, consisting on the resolution, individually or in group (maximum groups of 4 students), of a guide problem that collect the main practical aspects of the Content 5. The autonomous self-learning dedication is a estimation of the time that the student need afterwards the class for revising and consolidating the specific objectives of the activity.

**Support materials:**

Preparation / Study: The notes and presentations of the course for the Content 5, particularly the resolution of the examples which have ilustrated the introduction of concepts.

During the activity: The current material and the wording of the guide problem which the professor distribute in the same session.

**Descriptions of the assignments due and their relation to the assessment:**

The exercise is carried out by groups and simultaneously on the blackboard. The students must sign the class attendance, but they don't need to nad over the activity. The activity is not explicitly linked to the evaluation. Even so the student must have a minimum attendance of 50% in these problem sessions and lab classes of the Content C2.

**Specific objectives:**

At the end of the activity, the student should be able to:
- Use the random variable concept as an elemento for the description of the variability in a random experience and its modelling.
- Identify the probability distribution and the parameters of expectation and variance of these discrete and continuous random variables: Normal, t-Student, Khi^2 Pearson, as well as calculate associated probabilities of these random variables.
The evaluation of the subject is continuous, each content is evaluated separately from the arithmetic mean of the tests and written exams. The final mark of the subject is the arithmetic mean of the grades of the two contents.

For every content $C_i$ ($i=1,2$) there are three tests:
- $Q_i$: Random test with ATENEA, it has 8 questions, with one only answer and with penalization. The test is about the theoretical aspects and the elementary calculus of the $C_i$ content. The test takes 40 minutes.
- $P_E$: Exam with problems/questions about the $C_i$ content, it takes 80 minutes.
- $L_i$: Random test with ATENEA, it has 8 questions, with one only answer and with penalization. The test is about data analysis similar to the Integrated Project of the content $C_i$, it is necessary Minitab software to solve it. The test takes 40 minutes.

So that the $C_i$ content has a final mark: $N_i = \frac{(Q_i + L_i + 2 \cdot P_E)}{4}$. The final mark of the course is $N_f = \frac{(N_1 + N_2)}{2}$

$N_f$: Final mark of the course
$N_i$: Final mark of the $C_i$ content ($i=1,2$)

Alternately, if the student according to the section "Normas de realización de las actividades" cannot follow continuously the subject then the student will have the chance of doing a final global exam of the subject, consisting in a $Q$ test (40 min), a $L$ test (40 min) and a written test $P_E$ (80 min), with a final mark $N_f = \frac{(Q + L + 2 \cdot P_E)}{4}$.

Those students who don't follow the continuous evaluation in its two contents blocks and don't present to the final global exam will have a final mark of 0, NP.

Reassessment exam will be in the deadline set by the School.

All the marks indicated in this section are calculated over 10.
Regulations for carrying out activities

For doing the exams of the C1 and C2 contents, the student must comply with:

1) A minimum attendance of 2/3 in the classes for each content.

2) The student must do 3 self-learning tests for each content during the schedule disclosed in ATENEA at the beginning of the course.

3) Each content will have the higher of the self-learning test marks obtained in the 3 attempts and it is necessary that the student have a minimum of 5 points mean among the different contents.

ç) The student should obtain the qualification of 'pass' in the integrated project of each content.

Before the midterm exams of C1 and C2 it will be published in Atenea all the related information to the earlier requirements.

Those students who doesn't comply with some of these requirements will evaluate by the global final exam and won't take into account the possible midterm exam marks of C1 or C2. Anyway the self-learning tests are available during all the course for helping the students.

- If some of the evaluable activities of the first content C1 (Q1 test, PE1 written exam or L1 test) it will be considered as non marked. Exceptionally a student who couldn't do some of these activities and can justify it, at the discretion of the professor, could do it in the final exam schedule settled for the EPSEB.

- The evaluable activities Qi and Li (for i = 1,2) are done at the same time in a lapse of time of 80 minutes. The student can choose which test to begin first and the time dedicated to each one.

- For the activities the student cannot bring additional material, only a scientific calculator. If during the written exam it is necessary to use some probability table, it will be given with the wording.

Bibliography

Basic:


Others resources:

Minitab software version 16 or higher