

| 1. Key Information | | |
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| Module Code: 13605 | Module Title: Statistics II | |
| Credit Points: 6 | Module Status: Compulsory | Module Block: Basic Knowledge |
| Course Title: BSc in Engineering and Management | | Module Theme: Mathematics |

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| 2. Lecturer: | Esther Cabezas-Rivas | Tutorial Hours: | Friday from 12 to 14 (by appointment) |
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| 3. Required Reading: | |
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| <i>Statistical Quality Control</i> | D. C. Montgomery |
| <i>Design and Analysis of Experiments</i> | D. C. Montgomery |
| <i>Applied Regression Analysis</i> | N. R. Draper |
| <i>Time Series Analysis</i> | J. D. Hamilton |

| 4. General overview of the module |
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| <p>We will begin the subject with useful techniques aimed to analyse dependence relationships: <i>Linear Regression Models</i>. Next, we will focus on the particular challenges we can face using <i>Time – Series Analysis</i>, where the variable ‘time’ plays an essential role. In the second part of the subject we will examine how to develop an effective <i>Design Of Experiments (DOE)</i> with the aim to optimize processes. Related to this topic, we will study <i>Statistical Process Control (SPC)</i> as a useful tool for process management. The statistical competences you will acquire at the end of the course will help you in your professional career as regards to process improvement. Additionally, they will constitute a valuable support for making more informed decisions in your workplace.</p> |

| 5. Recommended prior knowledge | |
|--------------------------------|----------------|
| <i>Code</i> | <i>Subject</i> |
| 13604 | Statistics I |

| 6. Module objectives – Learning outcomes |
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| Basic and general Competences |
| <ul style="list-style-type: none"> • CB5 Develop learning competences for lifelong learning. • 02 Apply technologies, skills and economic tools for engineering and management. • 03 Define, solve and describe complex technical problems. • 04 Learn how to analyse different components which influence decision making processes. • 05 Communicate using scientific languages, based on graphical and symbolic elements used in engineering and management. |
| Specific Competences |
| <ul style="list-style-type: none"> • 13 Solve mathematical problems through the application of knowledge of algebra, linear algebra, geometry, differential geometry, differential and integer calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimizations. |

| 7. Teaching and learning units |
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| Unit |
| 1. Linear regression models <ul style="list-style-type: none"> • Simple Linear Regression • Least Squares method • Standard errors and coefficient of determination • Hypothesis test and confidence intervals • Multiple regression |
| 2. Time – series analysis <ul style="list-style-type: none"> • Components of a time-series • Moving averages method • Seasonal index method • Exponential smoothing • Autoregressive models |
| 3. Analysis of variance <ul style="list-style-type: none"> • ANOVA tables: one-way ANOVA, two way ANOVA with one or more observations per cell • Post – hoc analysis • Means and interaction plots • Hypotheses tests for equality of several means and interaction. |

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| <p>4. Design of experiments</p> <ul style="list-style-type: none"> • Introduction to design of experiments • Two – level factorial design • Fractional factorial design |
| <p>5. Statistical process control</p> <ul style="list-style-type: none"> • Application of statistics for process improvement • Introduction to control charts • Mean and range control charts • Process capacity |

| 8. Teaching and learning methods | | | | | | | |
|----------------------------------|--------------------|-----------------------|------------------------|------------------------|-----------------|-------------------|-------------|
| Unit | Theory (Classroom) | Practical (Classroom) | Practical (Laboratory) | Practical (Field work) | Practical (ICT) | Self-guided study | TOTAL HOURS |
| 1 | 4 | 4 | | | 4 | 20 | 32 |
| 2 | 4 | 4 | | | 4 | 25 | 37 |
| 3 | 4 | 4 | | | 4 | 20 | 32 |
| 4 | 4 | 4 | | | 4 | 20 | 32 |
| 5 | 4 | 4 | | | 4 | 20 | 32 |
| TOTAL HOURS | 20 | 20 | 0 | 0 | 20 | 105 | 165 |

| 9. Assessment | | |
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| Overview | Nº of activities | Weighting (%) |
| Continuous assessment | | |
| - Academic assignments. | 3 | 20 |
| - Multiple choice tests. | 4 | 20 |
| Exams | 2 | 60 |
| - Partial exam (during the course). Written open answer questions. | | 30 |
| - General exam. Written open answer questions. | | 30 |

Student evaluation will consist of both continuous and summative assessments:

1. Continuous assessment: The submission of practical work either carried out individually or in groups and participation in the different activities both inside the classroom, such as the analysis, summation and discussion of required readings, and outside including company visits, will account for this mark. This part of the assessment carries a weighting of 40% towards the final mark.
2. Summative assessment: These tests can combine both theoretical and practical content. This part of the assessment carries a weighting of 60% towards the final mark.

Continuous assessment is attendance based and non-recoverable. Therefore, the mark obtained for this part of the assessment will serve for both the first summative assessment and any subsequent repeat if required. The repeat will only be available at the end of the semester.

The first partial test will be done halfway through the semester. The second part test and the final exam will take place simultaneously at the end of the semester.

- Students who **pass the first partial test** (that is, obtain a grade ≥ 5 out of 10) will eliminate the subject of such test for the first general exam at the end of the semester, which means that they will only have to complete the second partial in the first general session.
- Students who **do not pass the first partial test** (that is, have obtained a grade of <5 out of 10) will be examined on the whole subject in the first general session.
- The **second general exam** will include all the material for all students.

To pass the module an average of 5 or more in summative tests must be obtained. If this condition is fulfilled, the final mark will be calculated by the average weightings of the summative assessment in combination with the continuous assessment; the final mark achieved must be 5 or above to pass the module. Otherwise, the final mark will be the one from the exam.

Attendance is compulsory to ensure that you extract the most value from the module and meet the learning requirements. Therefore, session absence accounting for more than 15% of the prescribed hours will result in the

inability to be awarded a mark for continuous assessment. Consequently, the maximum mark that can be achieved will be that obtained solely from the summative assessments.

Students enrolling in the module for the second time will receive specific instructions from their lecturer on what is required for them to pass the continuous assessment element. The final mark will be obtained by combining the summative assessment (80%) and the continuous assessment (20%), having to gain a final mark equal to or greater than 5 to pass the module. To pass the module an average of 5 or more in summative tests must be obtained. If this condition is fulfilled, the final mark will be calculated by the average weightings of the summative assessment in combination with the continuous assessment; the final mark achieved must be 5 or above to pass the module. Otherwise, the final mark will be the one from the exam.

All students must comply with the rules of writing, spelling and grammar in the development of their work and their assessment tests.