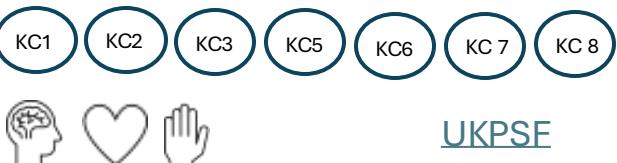# Statistic for Sustainability

Module: Statistical Methods for Engineering

This module introduces students to the basic statistical concepts and methods employed in solving engineering problems. While developing students ability to deal with data and apply statistical reasoning to real-world contexts, we emphasize using data for sustainability-related challenges. Sustainability contexts will be used to enhance relevance and foster critical thinking, social responsibility, and interdisciplinary awareness.

Learning outcomes:

L01 Determine the degree of relationships between variables in correlation analysis, and how one variable affects another variable in regression analysis, for a given scenario.

L02 State the hypotheses and/or assumptions, where appropriate, for single-sample t-test for population mean, two-sample pooled t-test, paired t-test and two-sample F-test, ANOVA test and Bonferroni Procedure post hoc test, chi-square goodness-of-fit test and non-parametric sign test

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L03 Perform hypothesis testing for single-sample t-test for population mean, two-sample pooled t-test, paired t-test and two-sample F-test, ANOVA test and Bonferroni Procedure post hoc test, chi-square goodness-of-fit test, and non-parametric sign test, to interpret research data.

L04 Apply appropriate statistical methods (e.g., t-test, regression, ANOVA, etc.) to analyze sustainability data

KC1 KC2 KC3 KC5 KC6 KC 7 KC 8

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How the specific learning objectives were targeted
By the end of the module the students were able to:

- Being able to analyse data in the sustainability contexts
- Recognise data can be used to support business decision and lifestyle choices with sustainability concern.

- Reflect on the social, economic and environmental impact of their own lifestyle choices.
- Reflect on the collective commitment
- Recognise the impact of our action to environment

- Critically analyse the relationship of different variables that could address environmental challenges.
- Use data to enable individuals to evaluate and make sustainable lifestyle choices.

How the specific learning objectives were assessed
- Learners will be assessed on their ability to analyse the data and identify variables can could contribute to address sustainability issues and be possible solutions.
- They will be assessed through transformative pedagogies approach like using authentic data, self-reflection and group presentation to justify their data analysis and proposal (authentic assessment).
- Each learner is evaluated in their ability to articulate as a group to analyse and interpret the data (communication skills).
- Each group of learners will be assessed based on the submission of the final document and on the oral presentation carried out in class.

How the SDGs targeted were embedded

SDG4: Implementing transformative pedagogies, embedding ESD in hand-on activity and fostering future thinking through reflection.

SDG6: Analysing authentic data and identifying the variables that could reduce water consumption in the industry, reflect on self and community responsibility in water consumption.

SDG 7: Investigating the relationship between air-conditioning temperature settings and energy consumption, and evaluating the potential contribution of alternative energy sources (e.g., solar energy).

SDG 11: Conducting a comparative analysis of the cooling effects provided by vegetation (trees) versus physical shelters to identify key environmental factors in sustainable urban development.

SDG14: Applying hypothesis testing to marine ecological data (e.g., coral bleaching severity) to validate observations and discuss the statistical implications for conservation efforts.

How were the learning and teaching activities designed and delivered?
Sustainability-related Problem Trigger:
Used authentic facts (e.g., water consumption volumes, marine pollution rates) to immediately connect lessons to real-world crises. Students were invited to investigate this data further.
Sustainability-related examples: Demonstrated data analysis techniques (e.g., regression, hypothesis testing) using many sustainability-related examples to emphasize the application.
Practice-based learning: After the demonstration, students immediately applied applied learned skills by solving case-study problems.
Collaboration Structured group work time for students to collaborate on problem solving, simulating professional team environments.
Reflection: Concluded every lesson with a mandatory reflection on how their statistical findings could be used to support and influence the chosen SDGs.