Course Title	**Evidence based medicine and Research Methods**				
Course Code	**VET-110**				
Course Type	Required				
Level	Undergraduate				
Year / Semester	Year 1/ Semester 2 (Spring)				
Teacher's Name	**Course Lead:** Dr Kostantinos Voskarides				
ECTS	6	Lectures / week	3	Tutorials / week	2
Course Purpose and Objectives	The main objectives of the course are: The move towards Evidence Based Medicine (EBM) on one hand and preventive medicine (Epidemiology and Public Health -PH-) on the other requires some knowledge by medical graduates in terms of Research Methods and Statistics and an ability to understand and critically assess medical research and epidemiological/public health literature. The course will provide the basic building stones for this outcome. Throughout the course medical and epidemiological examples will be used and teaching will always be put in context. Emphasis will be placed on understanding research rationale and research design and on interpreting (rather than calculating) statistics. The overarching objectives of the course are: • To understand the principles behind scientific research methods. • To understand the rationale behind research in the EBM, epidemiology/PH settings. • To cover the basic principles behind the most common study designs used in medical and healthcare research. • To introduce basic concepts of summarizing data, descriptive statistics and probability as well as samples and populations. • To cover the most common medical statistics such as quantification of risk, measures of association and measures of treatment efficacy. At the end of the course students should be able to approach the medical literature systematically and be prepared for acquiring further concepts related to epidemiology, public health and evidence-based medicine in the later years of the course.				
Learning Outcomes	The following list provides the learning objectives (LOBs) that will be covered in the lectures and lab practicals of each week: WEEK 1 • State what is meant by the term 'statistics'.				

	• Explain the importance of a statistical understanding to the animal scientist. • Distinguish between a qualitative/categorical and a quantitative/numerical variable. • List the types of scales on which variables are measured. • Explain what is meant by the term 'biological variation'. • Define the terms 'systematic error' and 'random error' and give examples of circumstances in which they may occur. • Distinguish between precision and accuracy. • Define the terms 'population' and 'sample' and provide examples of real (finite) and hypothetical (infinite) populations. • Summarize the differences between descriptive and inferential statistics. • Explain, with diagrams, the concepts of frequency distributions. • Interpret diagrams of the frequency distributions of both categorical and numerical data. • Identify frequency distributions that are skewed to the right and skewed to the left. • Interpret a pie chart, bar chart, dot diagram, histogram and a box-and-whisker plot and state their appropriate uses. • Interpret a scatter diagram and explain its usage. • List different measures of location and dispersion and identify their strengths and limitations. WEEK 2 • Calculate the mathematical probability of the occurrence of particular outcomes in simple events, such as dice-throwing and coin-tossing. • Elaborate the simple rules of probability – the addition rule and the multiplication rule for independent and dependent events – and illustrate each with a simple example. • List the main properties of the Normal distribution. • Explain how you might verify approximate Normality in a data set. • Define conditions under which measurements follow the Binomial distribution and give an example. • State when the Binomial distribution is approximated by the Normal distribution. • Explain the need to distinguish between a sample and the population. • Explain the concept of a sampling distribution.

	• Distinguish between the standard deviation and the standard error of the mean. • Give applications of the standard deviation and the standard error of the mean. • Explain why a confidence interval is useful. • Interpret the confidence interval for the mean. **Tutorial 1:** Probabilities' calculation. WEEK 3 • Distinguish between observational and experimental studies. • Describe what is meant by a clinical trial, longitudinal study, cohort study and case–control study. • Explain what incidence is, what is prevalence, the different types of risks and ratios and the differences between them. • Explain the need for a 'control' group in a clinical trial. • Explain the importance of randomization and describe methods for ensuring appropriate random allocation of individuals or groups. • Explain the importance of 'blinding'. • Describe the value of replication and blocking in experimental design. • Explain the term 'confounding' • Describe various approaches to handling confounders. • Define the term 'outlier' and describe methods to deal correctly with them. **Tutorial 2:** Basic epidemiological analysis. WEEK 4 • Elaborate the basic concept of hypothesis testing. • Define the null hypothesis. • Distinguish between one- and two-tailed tests and decide which is appropriate in any investigative trial. • Explain in simple terms the meaning of the term 'degrees of freedom'. • Interpret the P-value. • Summarize the hypothesis testing procedure. • Define Type I and Type II errors in hypothesis testing. • Define the power of a test.

	• Distinguish between statistical significance and biological importance. • Distinguish between the approaches to testing a hypothesis using a test statistic and a confidence interval, identifying the strengths and weaknesses of both. • Define what is a parametric and a non-parametric test. WEEK 5 • Distinguish between one- and two-sample tests. • Distinguish between the experimental designs that lead to either paired or two-sample t-tests. • Draw appropriate conclusions from the t-test. • Estimate the magnitude of the treatment effect when comparing means and calculate the relevant confidence interval. • List and explain the different forms of ANOVA tests. • List examples needing comparing more than two means. • Explain the problem of multiple comparisons. WEEK 6 • Explain how to test a hypothesis about a single proportion. • Outline the steps involved in comparing two proportions. • Construct a 2 × 2 contingency table of observed frequencies. • Explain the meaning of 'expected frequency' in a contingency table. • Explain when Fisher's exact test is appropriate instead of Chi-squared test. • Analyze frequencies in an r × c contingency table. • Describe the situations in which the Chi-squared test is not appropriate in the analysis of a contingency table. • Distinguish between causation and association. • Recognize a linear relationship in a scatter diagram. • Interpret Pearson's correlation coefficient. • Explain the value of r^2. • Test the null hypothesis that the correlation coefficient is zero. • Elaborate circumstances when it would be improper to calculate the correlation coefficient. • Use the regression equation for prediction. **Tutorial 3:** Statistical analysis software.

	WEEK 7 • Explain why sample size is an important design consideration. • List the factors that influence sample size determination. • Use Altman's nomogram to determine optimal sample sizes for numerical and binary data. • Explain the principles underlying a meta-analysis. • Describe the conditions to be fulfilled for random sampling. • Elaborate the different ways of selecting a sample. • Define the main types of papers. • Define the main parts of a research paper. • State the importance of PubMed database. • Appraise critically a research paper. **Tutorial 4:** Appraise critically a research paper. A WEEK 8 • Recognize when a survival analysis should be performed. • Interpret the results of Kaplan–Meier and Cox proportional hazards survival analyses. • What is the difference between basic and applied research. • Explain the concept of evidence-based veterinary medicine. • Describe the hierarchy of reliability of evidence and give reasons for the relative positions of types of evidence. • List the stages involved in practicing evidence-based veterinary medicine. • Identify the aspects of a study design that avoid bias. • From a report of a clinical trial, critically appraise the value of the evidence. • Explain what is meant by the absolute risk reduction (ARR) and the relative risk reduction (RRR). • Explain what is meant by the number needed to treat (NNT) and how to calculate the confidence interval for the NNT. • Interpret the usefulness of the evidence in the clinical/professional setting. WEEK 9 • Define qualitative research. • Describe the various qualitative methodologies. • Describe the process of coding qualitative data.

	• Describe the process of analyzing qualitative data. • Apply the basic qualitative methodology to analyze a specific case. **Tutorial 5:** Appraise critically a research paper. B WEEK 10 Revision		
Prerequisites	None	Required	None
Course Content	**Lecture Topics:** • Introduction to Biomedical Research • Introduction to measurement I: types of variables and basic summary statistics. • Introduction to measurement II: frequency distributions and the normal distribution. • Measures of frequency I: proportional measures • Measures of frequency II: rates • Measures of association I: The Risk Ratio and the Rate Ratio (Relative Risks). • Measures of association II: The Odds Ratio. • Measures of association III: mean difference between groups. • Measures of association IV: association of two numeric variables (correlation and linear regression). • Introduction to sampling and statistical inference I: samples, populations and the random error. • Introduction to sampling and statistical inference II: hypothesis testing and statistical significance (the 95% confidence interval and the p-value). • Systematic error in research I: selection bias and the different sampling methods. • Systematic error in research II: information bias (measurement error). • Introduction to confounding I: the multifactorial nature of disease and the concept of the confounder. • Introduction to confounding II: dealing with confounding (identifying 'independent' risk factors). • Causality in medical research: association vs causation. • Internal and external study validity.		

	• Types of study design I: Observational studies. • Types of study design II: Interventional studies. • The level of evidence in medical research. • Introduction to Qualitative research methods. • Introduction to Qualitative analysis Tutorial Topics: • Calculating and reporting prevalence, incidence and rates. • Calculating and reporting Relative Risks and Odds Ratios. • Interpreting measures of associations with numeric outcomes. • Identifying associations and judging on statistical significance. • Judging on the presence of selection bias and information bias. • Judging on confounding in associations. • Judging on causality and validity. • Judging on the type of study design and the level of evidence. • Basic analysis of qualitative data.
Teaching Methodology	Lectures, Tutorials.
Bibliography	1. Statistics for Veterinary and Animal Science, 3rd Edition, Aviva Petrie, Paul Watson 2. Research methods: A Framework for Evidence-Based Clinical Practice, Hurley 3. Epidemiology in Medicine, Volume 515, Charles H. Hennekens
Assessment	Course assignment: final written exam 60%, coursework 30%, attendance 10%.
Language	English