Overview of the Block 3 training course on "One Health, data and models for zoonotic disease management"

Introduction to modelling of diseases

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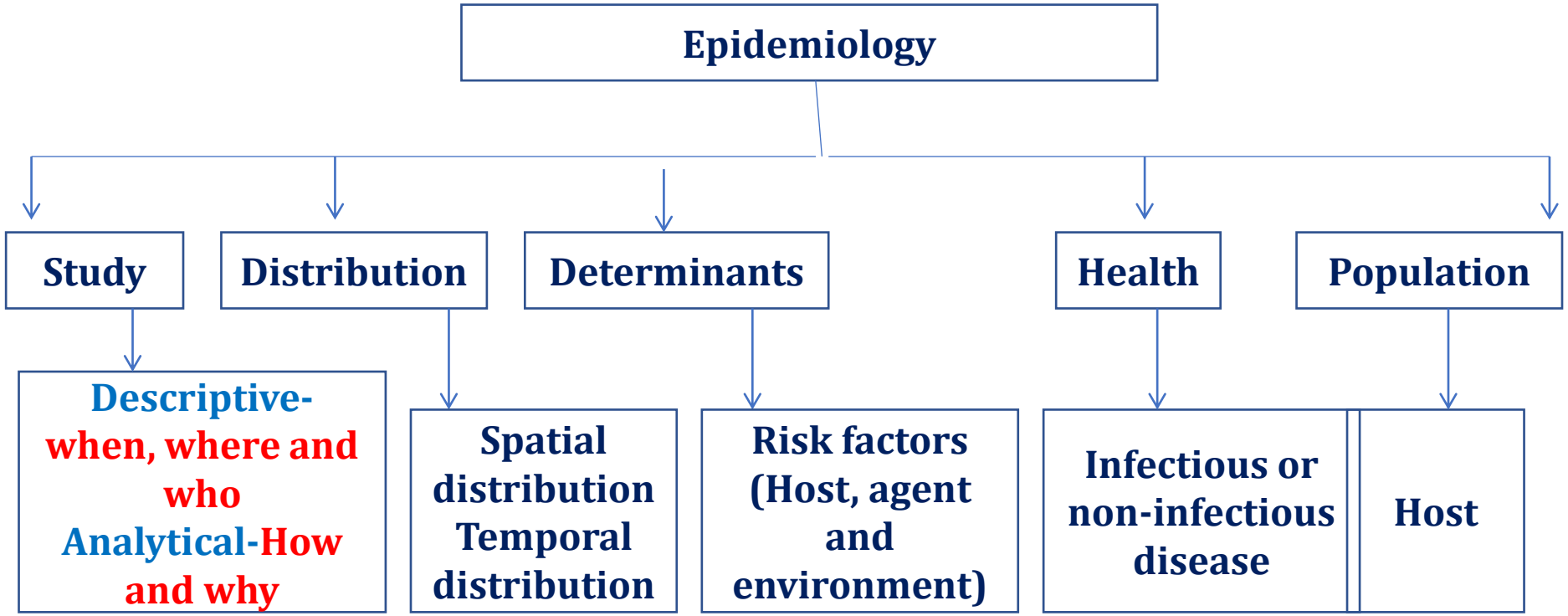
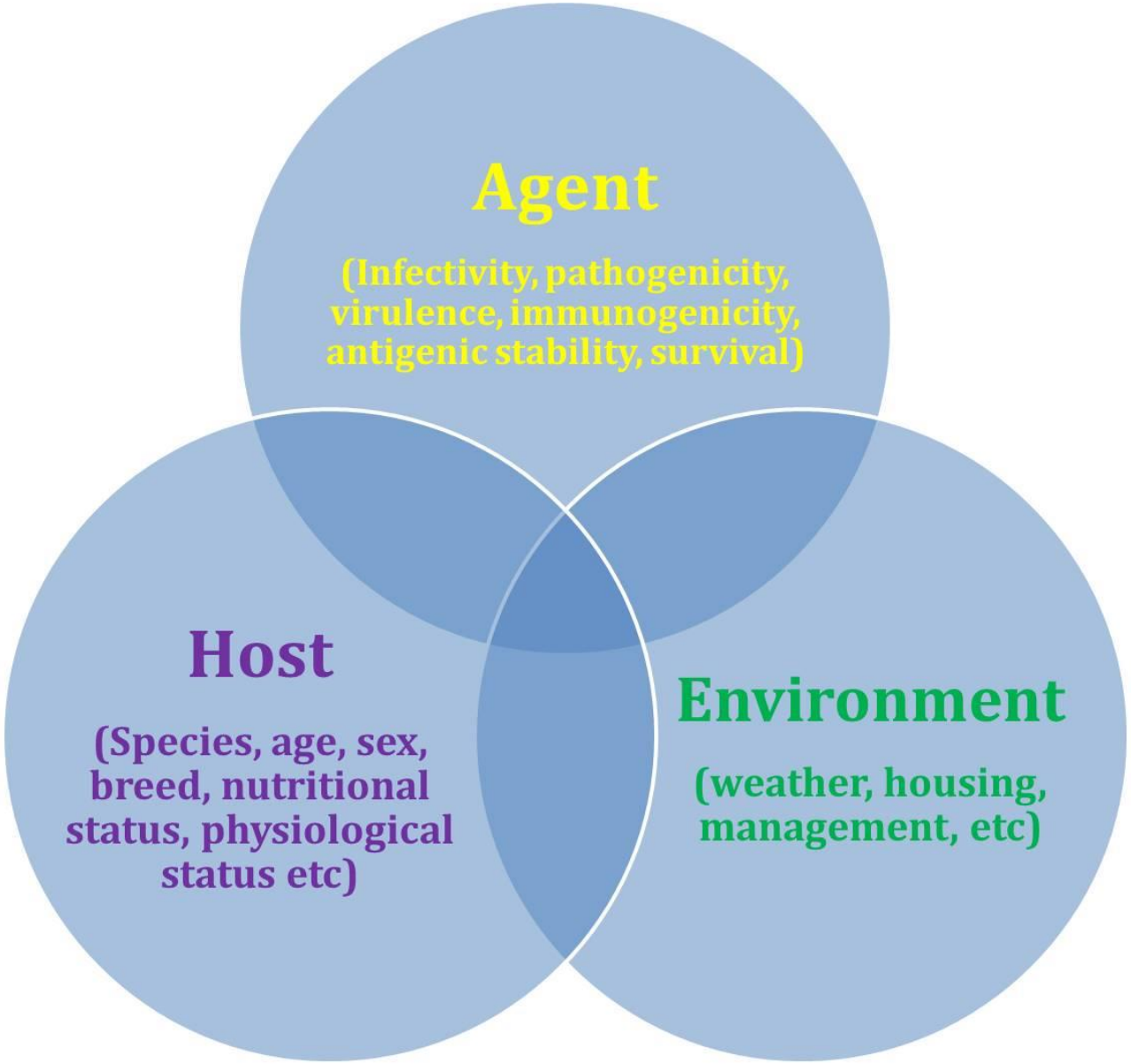
The **STUDY** of the **DISTRIBUTION** and **DETERMINANTS** of **HEALTH RELATED STATES** in specified **POPULATIONS**, and the application of this study to **CONTROL** of health problems





Definition of infectious disease (Last, 1995)

"An illness due to a specific infectious agent or its toxic products that arises through transmission of that agent or its products from an infected person, animal, or reservoir to a suceptible host, either directly or indirectly through an intermediate plant or animal host, vector, or the inanimate environment"

Some key terms to describe the infectious disease at the population level

- **Epidemic:** The occurrence in a community or region of cases of an illness clearly in excess of normal expectancy
- **Outbreak:** An epidemic limited to localized increase in the incidence of a disease
- **Endemic:**The constant presence of a disease or infectious agent within a given geographic area or population group
- **Pandemic:** An epidemic occurring over a very wide area, crossing international boundaries and usually affecting a large number of people

Last, JM. A Dictionary of Epidemiology. 1995.

Types of Variables

Because different types of variables are analyzed differently

- **Qualitative/categorical data**
  - Descriptions
  - Non-numeric information
  - Examples: Illness (yes/no), sex, district

- **Quantitative data**
  - Measurements
  - Numeric data
  - Examples: Age, height, number of children

Summarizing data

Mean, median, mode, arithmetic mean, range

Measure of Central Location – single measure that represents an entire distribution

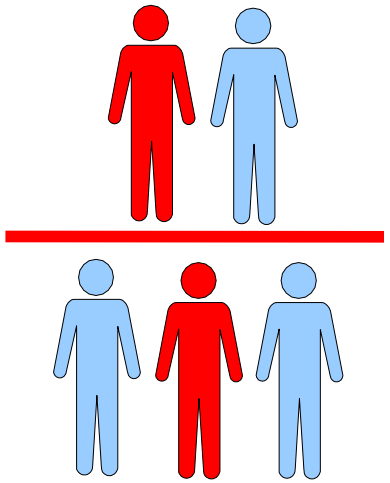
Mode – most common value

Median – central value

Mean – average value

Mean uses all data, so sensitive to outliers

Measures of Frequency

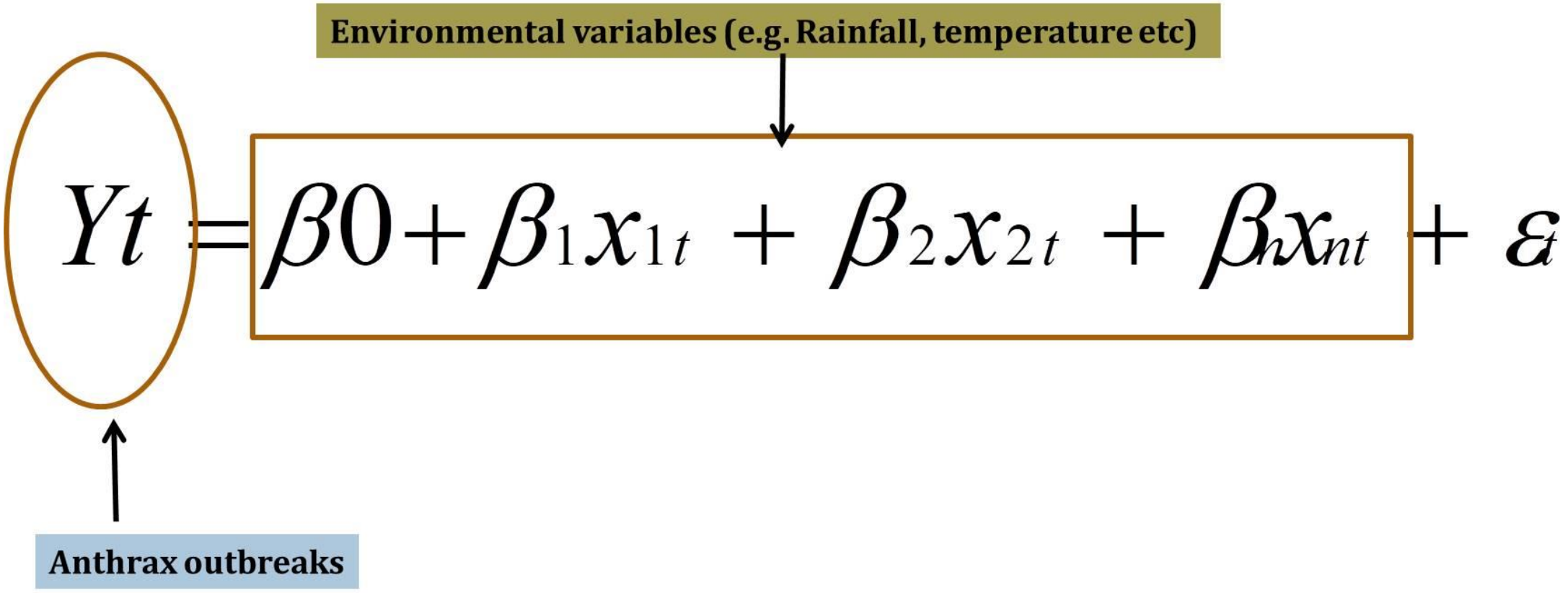


- **Counts**
- **Ratios**
- **Proportions**
- **Rates- incidence, prevalence, attach rate, CFR, Mortality rate and other rates**

Why develop a model?

- To **understand** the transmission dynamics in a population
- To help **interpret** observed epidemiological trends in a population
- To identify **key determinants** of epidemics
- To guide the collection of data
- To **forecast** the future direction of an epidemic
- To evaluate the potential impact of an **intervention**

Correlative models

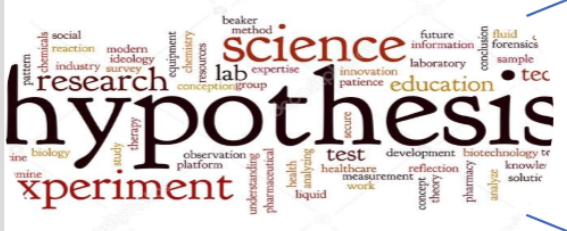


Variable	Co-efficient
Rainfall	-0.0010 (-0.0031, 0.0010)
Maximum temperature	-0.1292 (-0.2877, 0.0284)
Wet day frequency	0.0327 (-0.0244, 0.0897)
Sea surface temperature	0.0936 (-0.4479, 0.6335)
SST Anomaly	0.1794 (-0.3404, 0.7001)
Rainfall at lag 2	**0.0025 (0.0008, 0.0041)**
Rainfall at lag 5	**-0.0045 (-0.0071, -0.0019)**
Maximum temperature at lag 5	0.0121 (-0.0840, 0.1079)
SST at lag 15	-0.2820 (-0.7056, 0.1401)
SST Anomaly at lag 15 months	**0.4533 (0.0071, 0.8995)**

Types of transmission models

- Deterministic/compartmental – SIR model example – Categorize individuals into broad subgroups or "compartments" – Describe transitions between compartments by applying average transition rates – Aim to describe what happens "on average" in a population – Results imply epidemic will always take same course
- **Probabilistic/stochastic (Monte Carlo, Markov Chain)** – Incorporates role of chance and variation in parameters

Descriptive studies



Analytical studies

- Risk factor identification
  - Case-control, cohort, cross-sectional data
  - Ecological
  - Spatial modeling
- Risk mapping
  - Species distribution models
- Mechanistic models
  - Basic reproduction number
- Stochasitic models

Statistical/Correlation models

Transmission models

Intervention strategies

17-01-2022	**Day 1**	**18-01-2022**	**Day 2**
Activity	Lead Trainer	Activity	Lead Trainer
Drop in: Installing R and QGIS	Mudassar	**Risk factor analysis**	Dr Jeromie/Mudassar
BREAK		**BREAK**	
Lecture: Basic epi models & GIS	Mudassar	**Hands on: Risk factor analysis**	Dr Jeromie/Mudassar
Hands on: Basic epi models & GIS	Mudassar	**Hands on: R as a GIS**	Richard

19-01-2022	Day 3	20-01-2022	Day 4	21-01-2022	Day 5
Activity	Lead Trainer	Activity	Lead Trainer	Activity	Lead Trainer
BREAK		BREAK		BREAK	
Lecture: **Spatial statistics**	Pete	Lecture: **Time series modelling**	Pete/Richard	**Mechanistic models** for ZD	Ani Belsare
Lecture: **Risk mapping** for vectors & ZD	Beth	Hands on: time series modelling	Pete/Richard	Interactive Shiny App session	
Hands on: Spatial statistics	Pete				
Hands on: Risk mapping for vectors & ZD	Beth	Hands on: Risk mapping for vectors & ZD	Beth	**Participatory session**: Lessons learned, next steps for training/network, additional resources	Festus, Beth, Mudassar