



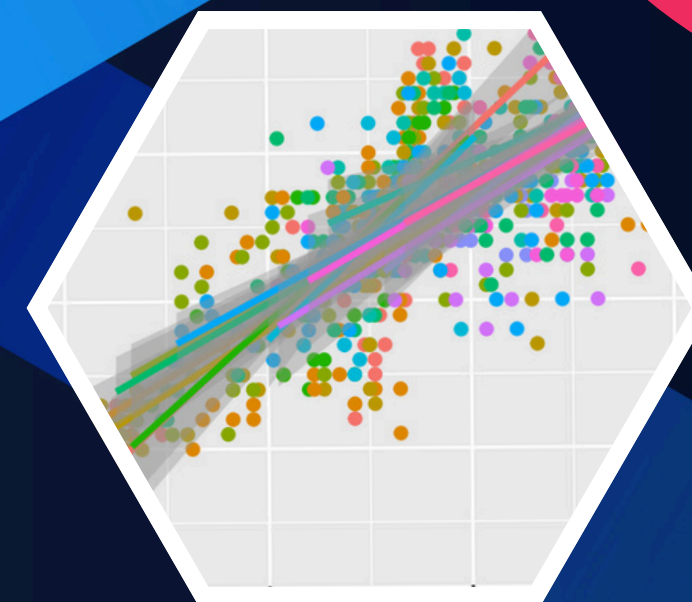
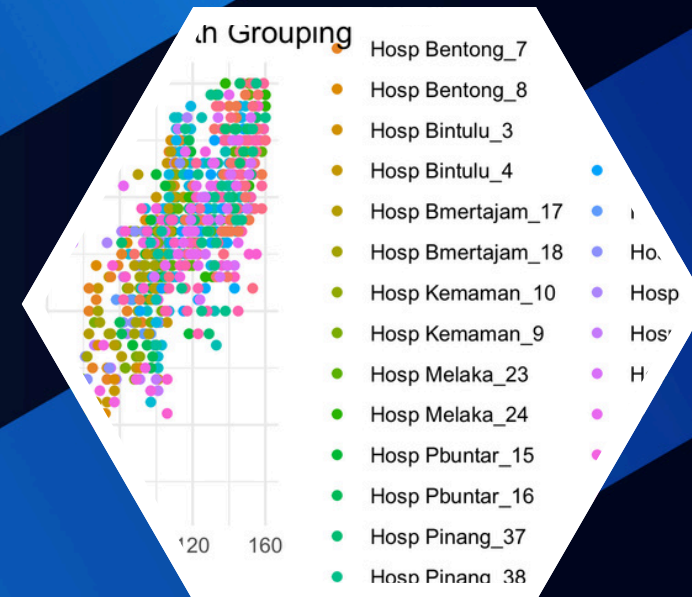
WEBINAR
EpiAnalytic Series 2025

BEYOND SIMPLE REGRESSION:

Unlocking Multilevel Models with lme4: use case in Clinical Decision-making among Nurses in Malaysia

NUR HIDAYAH ZAINAL

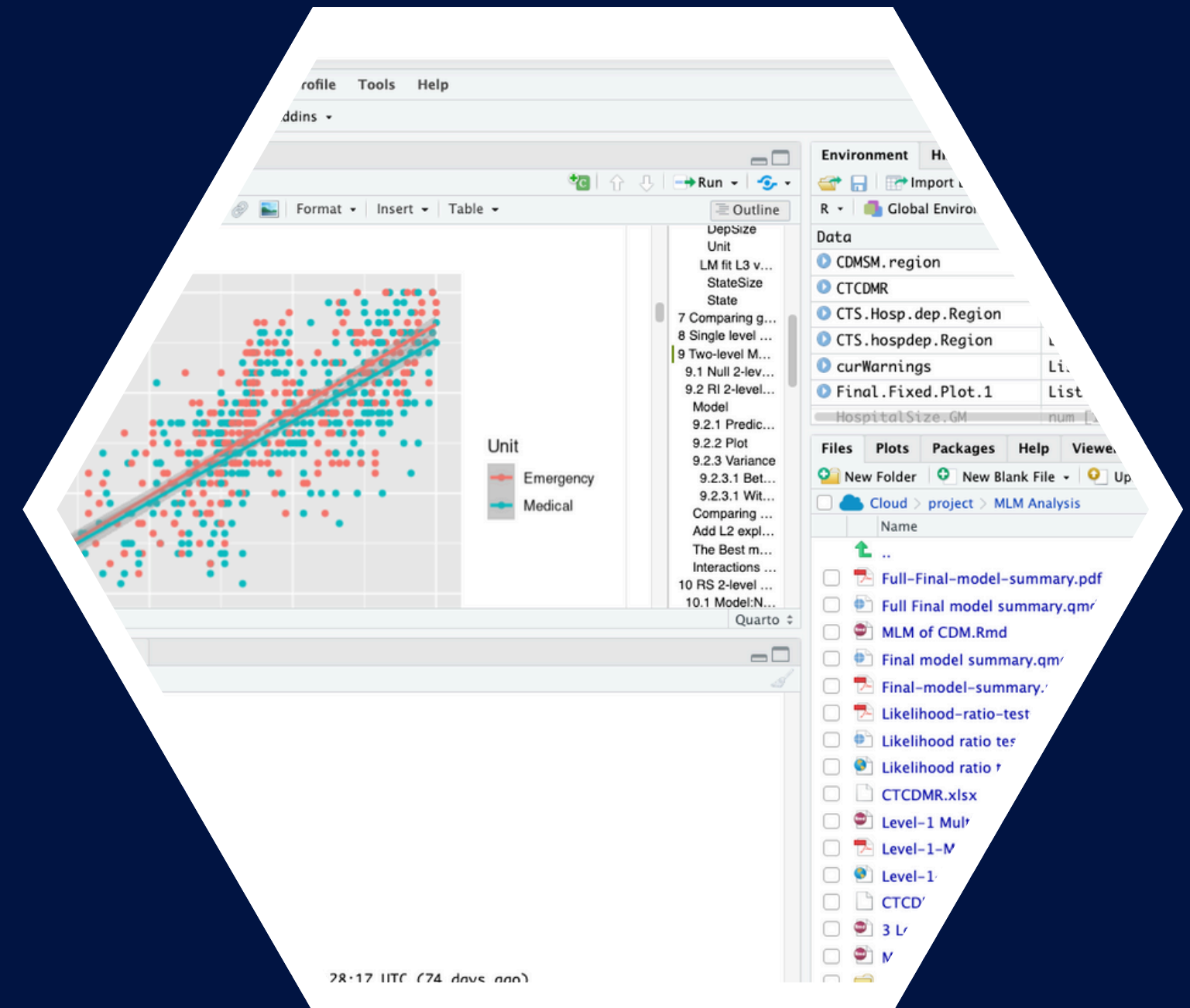
<https://github.com/eidaadz/A-three-multilevel-model-with-lme4.git>





OUTLINE

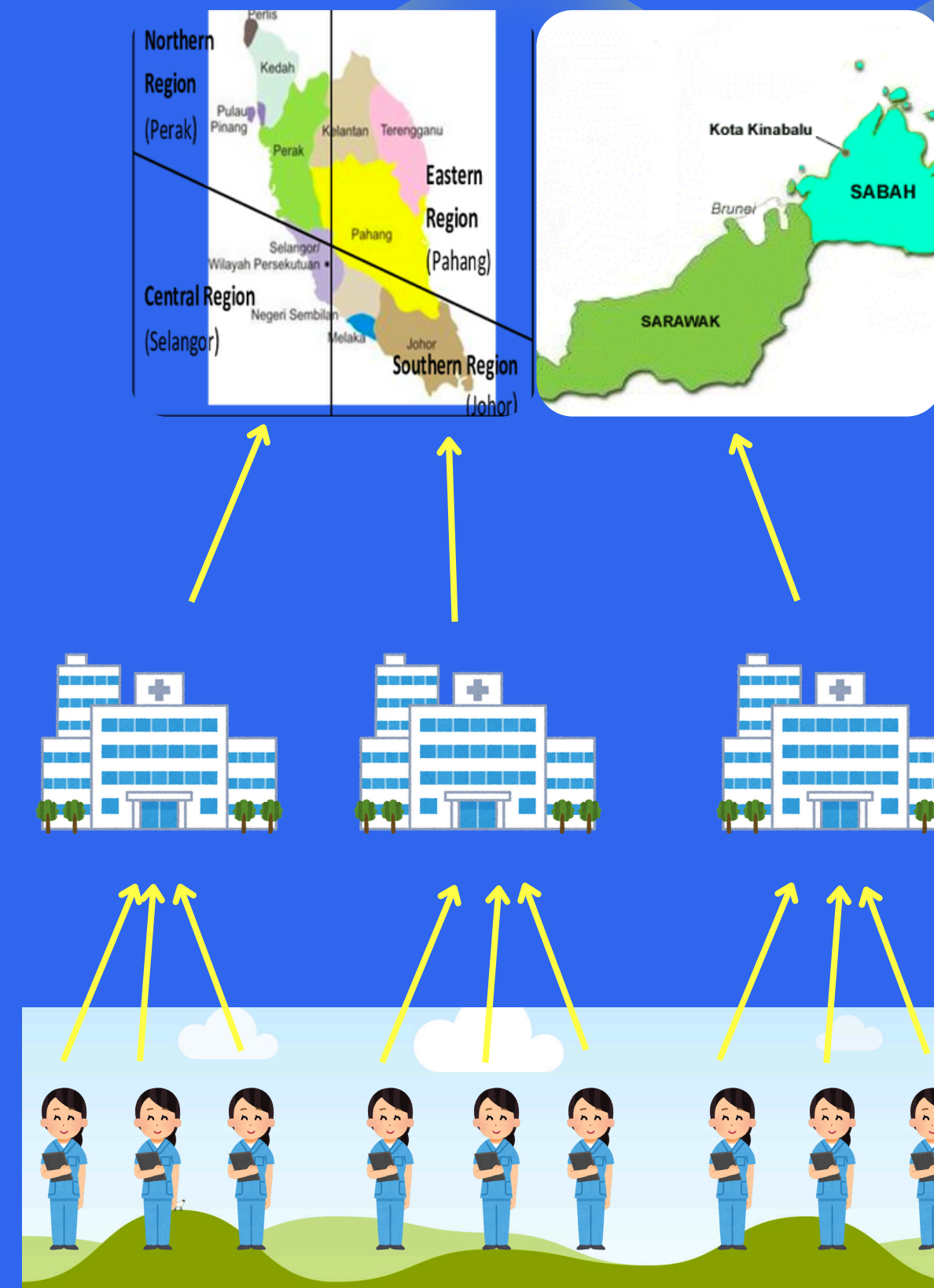
1. Overview on Multilevel Models
2. Why lme4
3. Lets code





What is multilevel model?

- Analyzes data with a hierarchical or nested structure
- Accounts for data points grouped or clustered within multiple levels
- Allows for the modeling of variation at different levels of the hierarchy, capturing both within-group and between-group variability.
- The individual nurse's scores are collected from multiple hospitals at one point in time, then observations within these hospitals are more likely to be similar.
- Fitting a regular regression to model this relationship between nurse's scores and some predictor variable x then we will be discounting the effects of hospital-level variables



Level 3

Level 2

Level 1



The lme4 Package: A Powerful Tool for Multilevel Modeling

Regional-level factors:

- Socioeconomic development
- Cultural factors
- Healthcare infrastructure

Hospital-level factors:

- Hospital type
- Staffing levels
- Hospital culture



a valuable tool to analyze how these regional and hospital-level factors influence the clinical decision-making skills of nurses across Malaysia.

- Account for the nested structure of the data: Nurses are nested within hospitals, and hospitals are nested within regions.
- Model the variation in decision-making skills across different hospitals and regions.
- Identify which factors at the regional and hospital levels have the most significant impact on nurse performance.

<https://cran.r-project.org/web/packages/lme4/lme4.pdf>



MIXED MODEL NOTATION

Four elements:

1. Outcome variable (Y)
2. Fixed predictors (A_i)
3. Random predictors (X_j)
4. Cluster variable (ID)

No random slope model:

$\text{lmer}(Y \sim A + (1 | ID), \text{data} = d)$

No predictor model:

$\text{lmer}(Y \sim 1 + (1 | ID), \text{data} = d)$

Simple model:

$\text{lmer}(Y \sim A + X + (X | ID), \text{data} = d)$

Multiple fixed effects model:

$\text{lmer}(Y \sim A_1 + A_2 + X + (X | ID), \text{data} = d)$

Multiple random effects model:

$\text{lmer}(Y \sim A + X_1 + X_2 + (X_1 + X_2 | ID), \text{data} = d)$

Multiple fixed and random effects model:

$\text{lmer}(Y \sim A_1 + A_2 + X_1 + X_2 + (X_1 + X_2 | ID), \text{data} = d)$



LETS CODE



CONCLUSION

Summary:

- explore the implementation of multilevel models using the lme4 package in R
- It allows for the analysis of data with hierarchical structures
- Also, enabling researchers to account for variability at different levels.

Key Points:

- encourage to understand mixed model notations
- mastering the steps to code
- work together to achieve better results by accurately capturing the complex relationship between levels & drawing more reliable conclusions





THANK YOU



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