# Introduction

The study investigates whether Egyptian fruit bats perceive black rats as competitors or predators, and how such interactions vary across seasons. Two authentic datasets provided by the zoological research team were analysed using modern data-science methods. The team revisited Investigation A and conducted Investigation B through data cleaning, exploratory analysis, statistical testing, and predictive modelling using Python.

# Methodology:

**Tools Used:** Python (Pandas, NumPy, Seaborn, Matplotlib, SciPy, Scikit-Learn).  
**Datasets:** dataset1.csv (individual bat events) and dataset2.csv (30-minute aggregated rat activity).  
**Approach:** Clean → Explore → Model → Interpret → Report.  
**Ethics:** No alteration of raw values; only derived variables and IQR-based outlier removal.

# Exploratory Data Analysis and Data Visualisation (Dipesh Wagle)

1. **Data Cleaning and Preparation:**

Both datasets (datasets1.csv and datasets2.csv) were imported and inspected for missing values, inconsistent types, and temporal formatting issues.

All time-related fields (start\_time, sunset\_time, rat\_period\_start, rat\_period\_end) were converted to proper datetime objects using dayfirst=True to align with the original field format.

Missing numeric values were imputed using median substitution, while categorical variables such as habit and season were encoded numerically to enable analysis.

Outliers were detected and removed using the Interquartile Range (IQR) method.

For example, in bat\_landing\_to\_food, 88 outliers were removed beyond the calculated upper bound (27.25 seconds). This cleaning improved the reliability of subsequent analyses by reducing data skewness and ensuring more consistent variance across variables.

After cleaning, Dataset 1 contained 819 valid observations, and Dataset 2 contained 2,123 aggregated records, both merged for cross-reference analyses.

1. **Descriptive Statistics and Summary Analysis:**

Summary statistics of key behavioural variables revealed the following patterns:

Average bat\_landing\_to\_food time = 5.7 s (SD = 6.48), with a maximum of 27 s after outlier removal.

Mean seconds\_after\_rat\_arrival = 280 s, indicating that bats often waited several minutes after rats arrived before approaching food.

Mean risk-taking behaviour = 0.46 (on a 0–1 scale), showing that most events were risk-avoidant.

Mean reward = 0.53, suggesting that just over half of all foraging attempts were successful.

The correlation analysis (Figure 1) revealed positive associations between reward and risk and moderate correlations between hours\_after\_sunset and bat\_landing\_to\_food, indicating that feeding behaviour may shift later into the night.

1. **Data Visualisations:**

A series of eight professional visualisations were generated to communicate behavioural and seasonal trends effectively:

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| Figure | Visualisation | Description |
| 1 | Correlation Heatmap | Shows relationships between continuous behavioural variables. |
| 2 | Histogram of bat\_landing\_to\_food | Displays the distribution and skewness of landing delays. |
| 3 | Scatterplot (seconds\_after\_rat\_arrival vs risk) | Reveals avoidance behaviour following rat arrivals. |
| 4 | Boxplot of risk by season | Compares behavioural risk across winter and spring. |
| 5 | Violin Plot (reward vs habit) | Illustrates variability in reward across behavioural contexts. |
| 6 | Monthly Trend Line (month vs bat\_landing\_to\_food) | Shows temporal variation in landing behaviour. |
| 7 | Scatterplot (rat\_arrival\_number vs bat\_landing\_number) | Demonstrates correlation between rat activity and bat foraging frequency. |
| 8 | Bar Chart (reward rate by season) | Summarises how success rates differ across seasons. |

These plots together form a coherent data story: bats demonstrate adaptive foraging strategies depending on both rat presence and seasonal food availability.

1. **Key Findings:**

* Bats delay approaching food when rats are present, indicating perceived risk or avoidance.
* Spring seasons show increased risk-taking, likely due to higher food competition.
* Rat activity correlates positively with bat landings, confirming competition dynamics.
* Outlier analysis highlighted rare extreme-risk events, consistent with natural variability.
* Reward probability rises with risk-taking behaviour, supporting optimal foraging theory.

1. **Link to Predictive Modelling:**

These findings directly inform the Linear Regression modelling stage. Variables such as bat\_landing\_to\_food, seconds\_after\_rat\_arrival, and season are strong candidates for explanatory or response variables, providing a foundation for predictive analysis in the subsequent section of this report.

# Predictive Modelling and Statistical Analysis (Prakash)

1. **Model Selection and Feature Engineering**
2. **Normality Testing and Assumption Validation**
3. **Linear Regression Models (Investigation A & B)**
4. **Model Evaluation and Optimisation**
5. **Interpretation of Results**

# Results and Discussion (Bishal)

1. Presentation of Findings
2. Comparative Seasonal Analysis
3. Interpretation and Implications
4. Limitations

# Teamwork Management and Documentation (Pralin)

1. Team Coordination and Communication
2. Documentation and Version Control
3. Submission Management

# Conclusion

This study reveals that Egyptian fruit bats modify their foraging behaviour when rats are present and that these changes are seasonally dependent. The integration of EDA and Linear Regression provided quantitative support for these ecological hypotheses. The project demonstrated practical application of data-science skills in real-world biological contexts.

# References

# Individual Contributions

Dipesh Wagle: Conducted data cleaning, outlier handling, EDA, and visualisation; produced figures and EDA summary.

Prakash: Developed and validated linear regression models, performed statistical tests, and interpreted coefficients.

Bishal: Authored introduction, methodology, results, discussion, and conclusion sections.

Pralin: Managed communication, documentation, and final report assembly and submission.