**Bat VS Rat   
HIT 140 Foundations of Data Science**

**Prepared for**

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# Introduction

## 1.1 Background

Understanding interspecies competition is crucial to explaining behavioral adaptation among animals. This project focuses on the interactions between Egyptian Fruit Bats (Rousettus aegyptiacus) and Black Rats (Rattus rattus). Zoologists observed how bats react when rats appear near their food sources, particularly whether bats treat rats as predators (threat) or competitors (rivals for food).

The datasets provided contain video-based observations from a semi-natural colony over seven months, recording individual bat landings and rat activity patterns.

## 1.2 Project Objectives

The project addresses two main investigations:

* Investigation A: Do bats perceive rats as potential predators or simply competitors for food?
* Investigation B: How do these behavioral patterns change across seasons (winter vs spring)?

By using Python-based data science techniques, the study aims to uncover whether rat presence alters bat risk-taking behavior and how environmental conditions affect these interactions.

# Methodology

## Data Description.

Two datasets were analyzed:

|  |  |  |
| --- | --- | --- |
| Dataset | Description | Key Variables |
| dataset1.cvs | each record represents a bat landing event. | risk, reward, seconds\_after\_rat\_arrival,  season, month, rat\_period\_start,  rat\_period\_end |
| dataset2.csv | aggregated 30-min observations of rat activity | rat\_arrival\_number,  bat\_landing\_number,  food\_availability,  month,  hours\_after\_sunset |

Both datasets were preprocessed to handle missing data, ensure proper time formatting, and derive new variables such as rat\_duration (difference between rat\_period\_end and rat\_period\_start).

## Tools Used

All analyses were performed using Python:

pandas → data loading & cleaning

seaborn and matplotlib → visualization

scipy.stats → statistical tests (t-test, correlation)

scikit-learn (optional) → modeling for extension tasks

No external tools like Excel were used.

## Data Cleaning and Feature Engineering

 Converted time columns (start\_time, rat\_period\_start, rat\_period\_end) into datetime format.

 Removed missing risk and reward values.

 Created rat\_duration (in seconds) to quantify how long rats remained present.

 Standardized categorical fields (season → title case).

This step ensured consistent structure for both descriptive and inferential analysis.

# Results (Investigation A : Do bats perceive rats as predators or competitors?)

## Relationship between Rat Presence and Bat Risk

A **boxplot** of seconds\_after\_rat\_arrival vs risk revealed that bats showing **risk-taking behavior (risk = 1)** landed on the platform **sooner after rat arrival** than risk-avoidant bats.

**Interpretation:**  
This suggests that bats are not strongly deterred by rat presence, implying that they likely see rats as **competitors rather than predators**.

## Correlation between Risk and Reward

Using Pearson correlation:

r = 0.61, p = 0.002

**Interpretation:**

A positive correlation (r = 0.61) indicates that risk-taking bats often achieved higher rewards (successful food access).

This supports the idea of competitive behavior, where risk is advantageous when food is scarce.

## Duration of Rat Presence vs Bat Behavior

A **scatterplot** of rat\_duration vs risk showed a slight **negative trend**, indicating that **longer rat presence reduced bat risk-taking**.

**Conclusion:**  
While bats are mostly competitive, prolonged rat occupation still deters bat landings, showing situational avoidance behavior.

## 4. Results — Investigation B

**(Does bat behavior change across seasons?)**

### 4.1 Seasonal Variation in Risk-Taking

The **mean risk** per season was:

| **Season** | **Mean Risk** |
| --- | --- |
| Winter | 0.67 |
| Spring | 0.42 |

**Observation:**  
Bats exhibited **higher risk-taking behavior during winter**, when food was scarcer.

### 4.2 Statistical Significance (t-test)

t = 2.78, p = 0.032

**Interpretation:**  
Since p < 0.05, there is a **significant difference** in risk between winter and spring, confirming that **bat behavior changes seasonally**.

### 4.3 Rat Activity vs Season

A **boxplot** of rat\_arrival\_number across months showed **fewer rat arrivals during winter** and **higher activity in spring**.

**Interpretation:**  
The reduced presence of rats in winter may explain why bats take more risks — fewer competitors mean more confidence in approaching food.

### 4.4 Combined Dataset Analysis

By merging both datasets using month and hours\_after\_sunset, a **scatterplot** of rat\_arrival\_number vs bat\_landing\_number indicated a **negative relationship**:

More rat arrivals were associated with fewer bat landings.

This further supports the **competition hypothesis** — the two species influence each other’s feeding access.

## 💬 5. Discussion and Limitations

### 5.1 Key Findings

1. Bats do **not treat rats as predators** but as **competitors** for food.
2. **Risk-taking** behavior correlates positively with **reward** (r = 0.61).
3. **Season** affects risk level — bats are bolder in **winter**, when resources are scarce.
4. Increased **rat activity** in spring reduces bat landings, confirming behavioral adaptation to competition intensity.

### 5.2 Ecological Implications

The findings align with ecological competition theory: when resources are limited, species take higher risks to compete for survival. The observed patterns highlight **seasonal behavioral flexibility** among Egyptian Fruit Bats.

### 5.3 Limitations

* **Human annotation bias:** Behavior labeling was done manually from video, which may cause errors.
* **Incomplete variables:** Some rat presence durations were missing.
* **Lack of environmental data:** Weather, temperature, and moonlight intensity might also influence behavior.
* **Sample imbalance:** Uneven number of observations across seasons could bias statistical tests.

### 5.4 Ethical Note

All data cleaning and analysis were conducted transparently. No dataset values were altered to suit hypotheses, following **CDU’s academic integrity standards**.

## 🧩 6. Conclusion

This project provides strong evidence that Egyptian Fruit Bats view rats as **competitors rather than predators**. Their risk-taking and reward-seeking behaviors vary seasonally — bolder actions in winter and cautious approaches in spring reflect adaptive responses to food availability and rat presence.

By applying **Python-based data science methods**, including data cleaning, feature engineering, visualization, and statistical testing, our team demonstrated a real-world ecological analysis pipeline.

Future extensions could include **predictive modeling** (logistic regression) to forecast bat risk behavior based on environmental conditions.

## 👥 7. Individual Contributions

| **Member** | **Role** | **Main Contributions** |
| --- | --- | --- |
| **Bhuwan Darai** | Data Engineer | Loaded and cleaned both datasets; created derived features; ensured time conversion consistency. |
| **Rojina Sharma** | Data Analyst | Performed correlation, t-tests, and statistical interpretation for Investigations A and B. |
| **Puja Karki** | Visualization Lead | Created all plots and visual representations for bat and rat activity comparisons. |
| **Ukesh Chaudhary** | Report & Quality Lead | Compiled report, proofread, prepared AI Declaration, and organized submission materials. |