# Termite Foraging Project

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# Introduction

- 30 plots established during a single week in June 1984.
- Each was a square grid (6x6 meters) of 25 toilet paper rolls which served as termite bait.
- Plots were examined every week during the first 5 weeks, and at least every month thereafter until August 1985 to obtain an "attack sequence"
- **Do termites forage "randomly" or "systematically"?**

<u>Null, *H0* (random foraging):</u>
*"All unattacked rolls are equally likely to be attacked"*

<u>Alt, *H1* (systematic foraging):</u>
*"Rolls closer to those already attacked are more likely to be attacked"*

# Monte Carlo method

test statistic *T*: sum of squared Euclidean distances between each attacked roll and the closest previously-attacked roll.

- also used regular Euc. dist., which punishes far rolls less severely
- low values suggest systematic foraging, but how low is “low”?

Hard to derive the distribution of *T* under *H0* analytically...

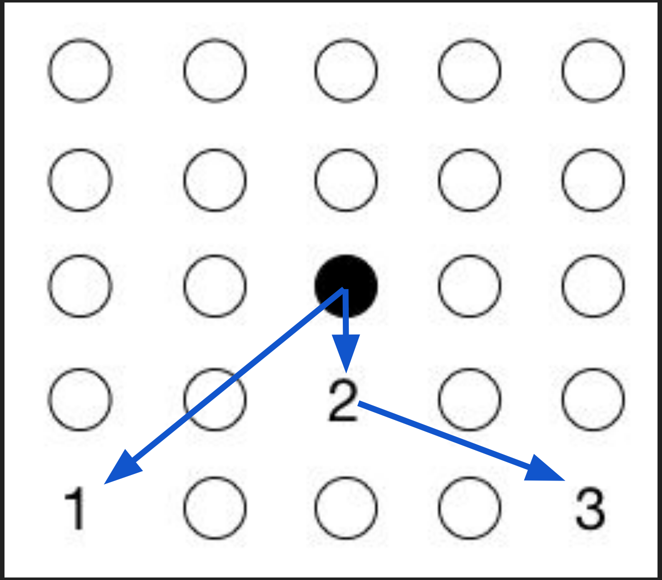
- depends on initial roll(s) & number attacked after

so, we can <u>estimate this distribution by simulating </u>plots under *H0*.

- for each plot, simulate attack seq. w/ same initial roll(s) & # attacked
- let each unattacked roll be equally likely to be next in the sequence

Then we can measure how “low” an observed T value is via its quantile.

# Teaching Example: Plot 5




Euclidian Test Statistic:

$$T = \sqrt{(2^2 + 2^2)} = \sqrt{8}$$

$$+ 1 = 1 + \sqrt{8}$$

$$+ \sqrt{(2^2 + 1^2)} = 6.064$$

Squared Test Statistic:

$$T = \sqrt{(2^2 + 2^2)}^2 = 8$$

$$+ 1^2 = 9$$

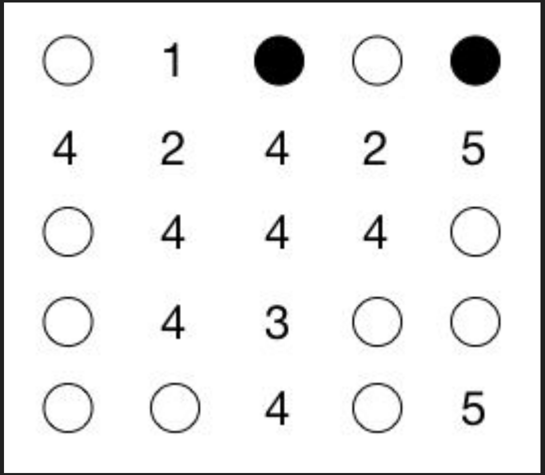
$$+ \sqrt{(2^2 + 1^2)}^2 = 14$$

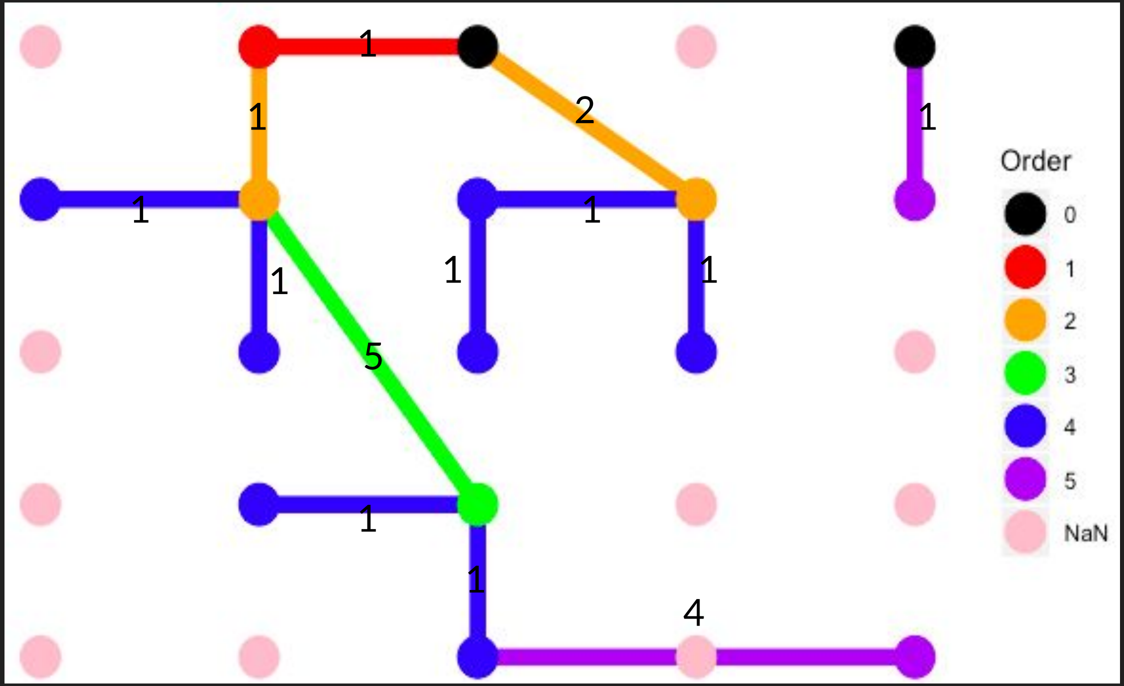
Significance Probability (100,000 simulations):

p-value = 0.888

p-value = 0.857

# Plot 20

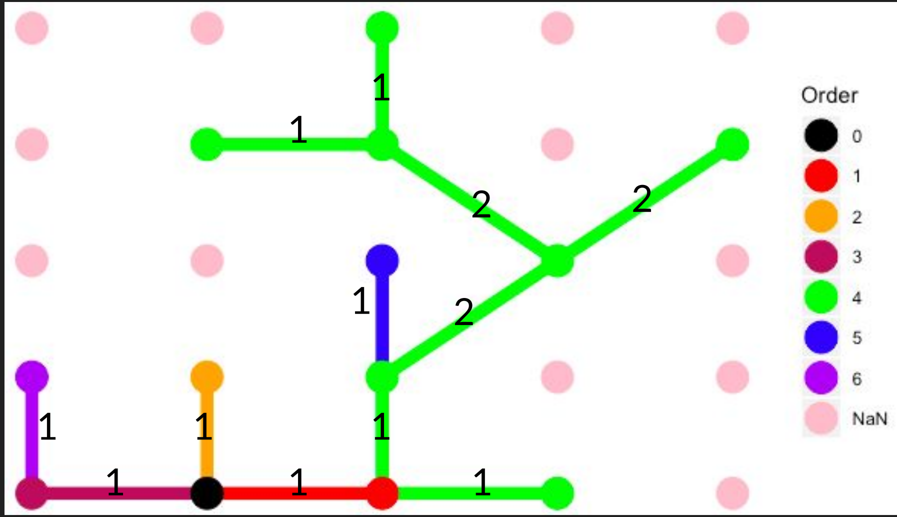


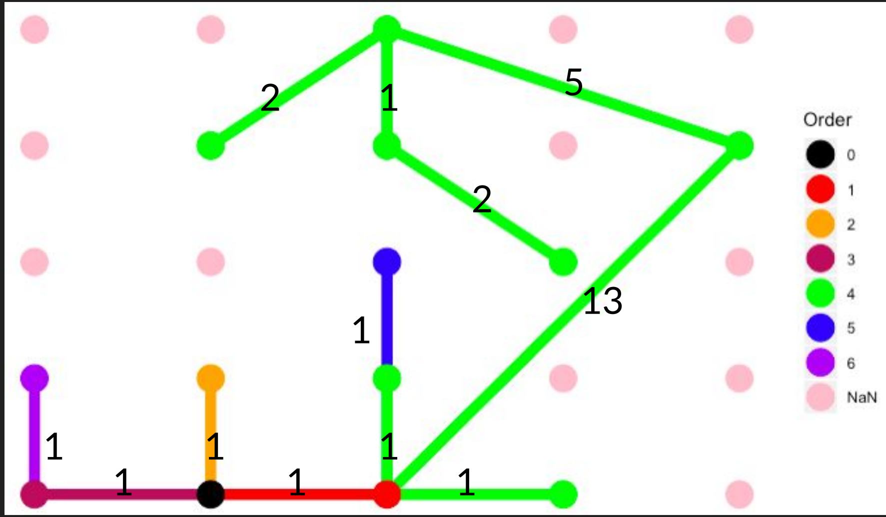

$T = 21$
p-value = 0.050

# Plot 24

ties: different possible $T$

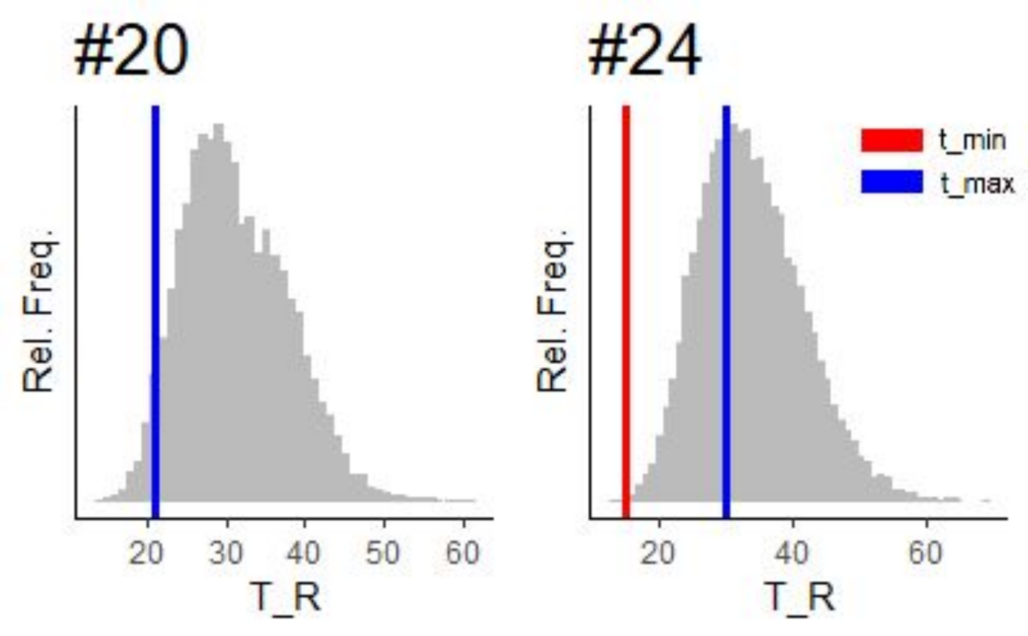



$T\_min = 15$
p-value = 9e-05



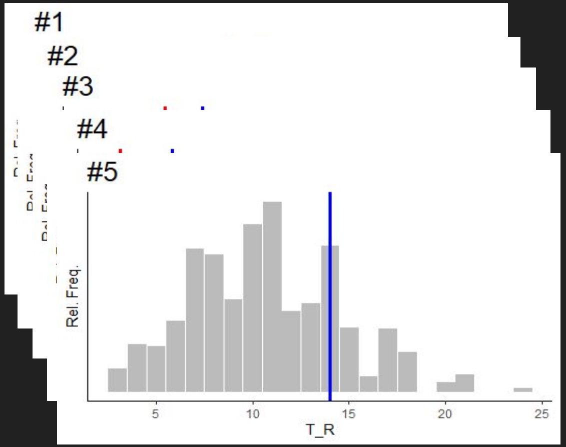

$T\_max = 30$
p-value = 0.222

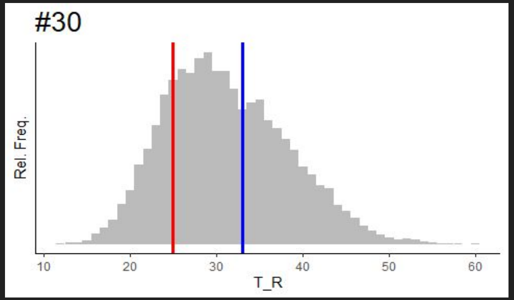
# Histograms for Plots 20 & 24




*50,000 simulations: 99% CI for p is ± < .006

# Aggregating the plot data

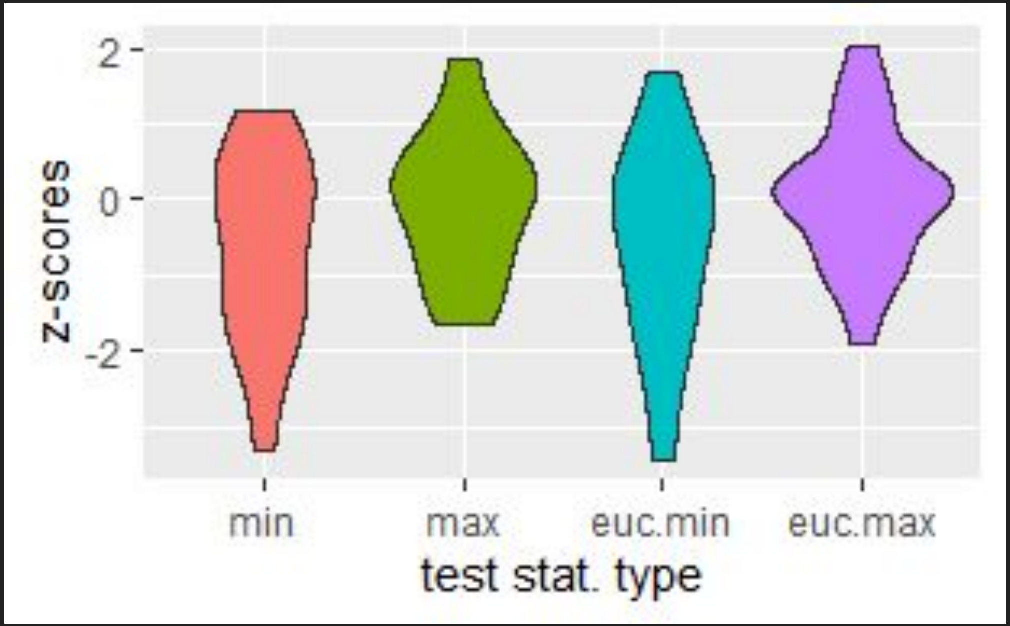



- Collect the <u>z-score</u> for each *T_min/ T_max*
- Most simulated distributions are ~*Normal* (although clear exceptions exist)
- Plots are independent
- Thus, we can perform a rough <u>t-test</u> to compute *p* for *H0* across all 27 plots: *mean(z)~t(df=26)*

# Aggregated results

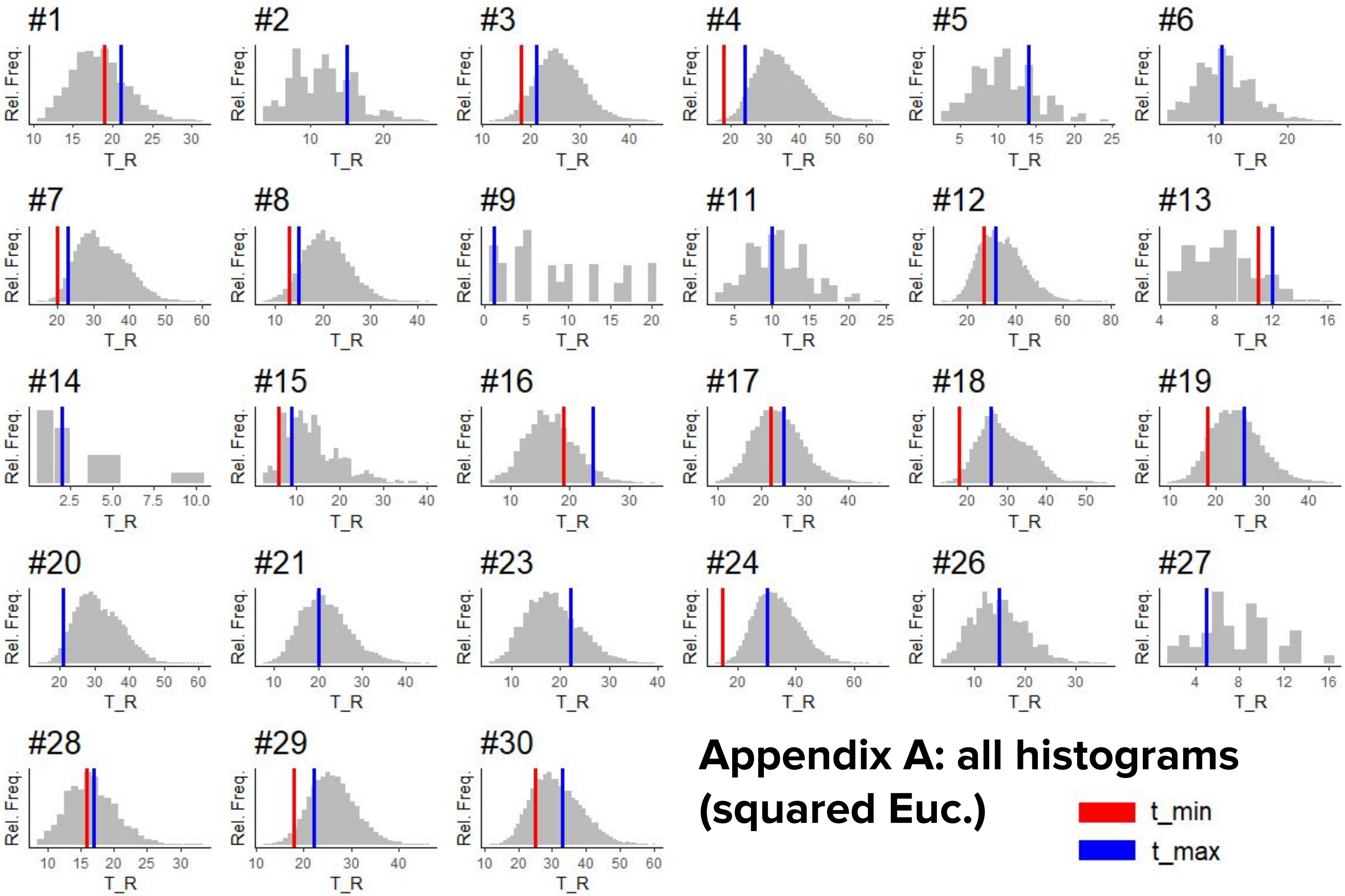
| *t_min* | *t_max* | *t_min*, Euc. | *t_max*, Euc. |
|---|---|---|---|
| .01 | .77 | .03 | .81 |




*t_min* suggests systematic foraging;
*t_max* suggests random foraging.

# Conclusions

- Simulation results with *t_min* suggest systematic foraging, but with *t_max* show no evidence of non-random behavior.
- To resolve this, we must get rid of ties: higher-frequency observations are warranted.
- Squared distances penalize far rolls more severely, but the aggregate results for squared and regular Euclidean distance were similar nonetheless.
- Future exploration: other methods of “systematic” foraging?




# Appendix A: all histograms (squared Euc.)