

An Analysis of Professor Bumpus' Sparrow Data

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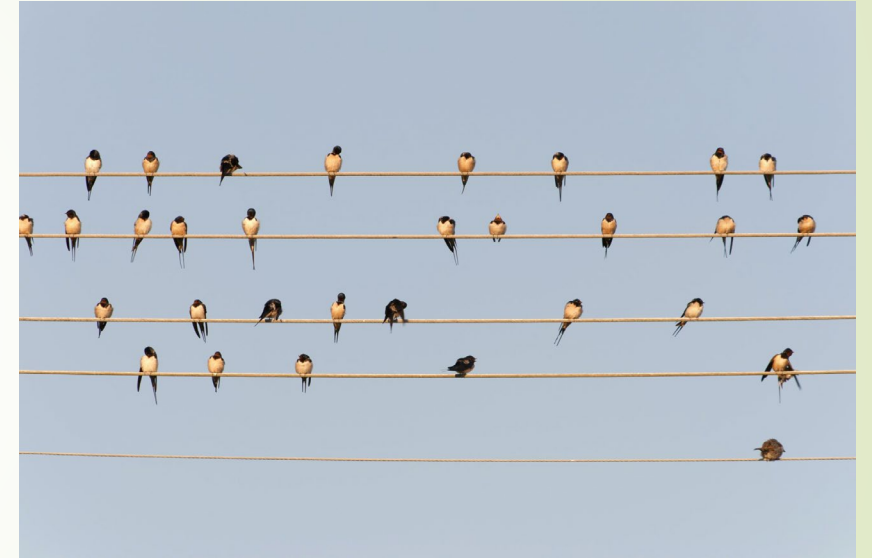


“The most influential ornithological paper published.”: Professor Herman Bumpus.

- Bumpus was born in Maine in 1862, and entered Brown in 1879 to study biology, graduating in 1884. In 1886, he accepted a professorship at Olivet College in Michigan, a position he left in 1889 to complete a doctorate at the newly established Clark University, where he received the first PhD awarded by that university.
- The American Ornithological Society claims that the paper “*The elimination of the unfit as illustrated by the introduced sparrow, Passer domesticus*” as “Possibly the most influential ornithological paper published in North America in the 19th century.”

The Sparrow Data


- On 1 February 1898, a winter storm in Providence provided Bumpus with the material for another summer lecture at Woods Hole, which he then published. After the storm, 136 immobilized sparrows were brought to Bumpus's anatomy lab, where 72 subsequently revived but the remaining 64 died. Bumpus identified the sex and measured nine morphological traits of each bird.
- Bumpus hypothesis was that there were significant differences between the Sparrows that died and those that didn't.





Bumpus' Conclusions

- On his paper, Bumpus claims, "...the birds which perished have certain average structural peculiarities which distinguish them from the survivors, and that the intensity of selective elimination has been felt most by birds of extreme structure." (Bumpus HC).



Testing the conclusion of Bumpus

Methodology:

- Hypothesis testing.
 - H0: The mean values of the data variables between groups are not significant
 - H1: The mean values of the data variables between groups are significant
- Dataset: Bumpus data accessible at the North Dakota State University website.
- Statistical Tests:
 - Hotelling's T^2 Test
 - Levene's Test
- Tools: R software

Hotelling's T^2 Test for Mean Sample Vectors Between Deceased and Survived groups

► With a P-val = 0.7622, we have no evidence that there is a difference between the 2 sample mean vectors.

► However, Hotelling's T^2 Test assumes the covariance matrices between the 2 samples are the same. Thus, we need to show the covariances are the same.

Mean Sample Vectors for Groups Deceased and Survived on Bumpus Data with P-val = 0.7622

Group	Length	Alar	Head	Humerus	Sternum
Deceased	158.43	241.57	31.479	18.446	20.839
Survived	157.38	241.00	31.433	18.500	20.810




Levene's Test for difference in variability among Deceased and Survived groups.

► Our Levene's test shows no evidence there is a difference in the covariance matrices between the groups of deceased and survived Bumpus data.

Levene's test on mean deviations:

Degrees of Freedom	Pillai Test	Pr(>F)
1	0.10762	0.4082



Conclusions and errors

We have no evidence to reject our null hypothesis. Therefore, we can estimate that there is no difference between the Sparrows that died and Sparrows that survived.

We could be making a Type 2 error by not rejecting the null hypothesis when it's wrong.



Work cited

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