

Population dynamics

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Births



Deaths



**Births and immigration
add individuals to
a population.**



**Deaths and emigration
remove individuals
from a population.**

Immigration



Emigration



Skyline plot

- A method-of-moments estimate of a piecewise model
- effective population size through time

- The classic skyline plot
- The generalized skyline plot

- Contemporaneous sequences
- Heterochronous sequences

The classic skyline plot

the coalescent event time

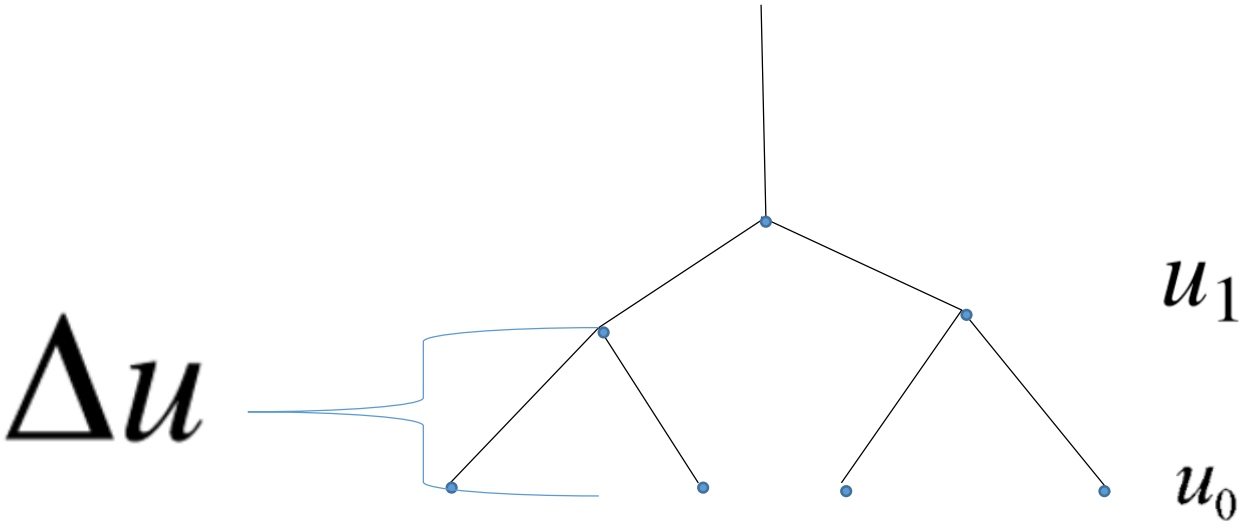
$$\mathbf{u} = \{u_1, u_2, \dots, u_{n-1}\}$$

The classic skyline plot

- The waiting times between coalescent events

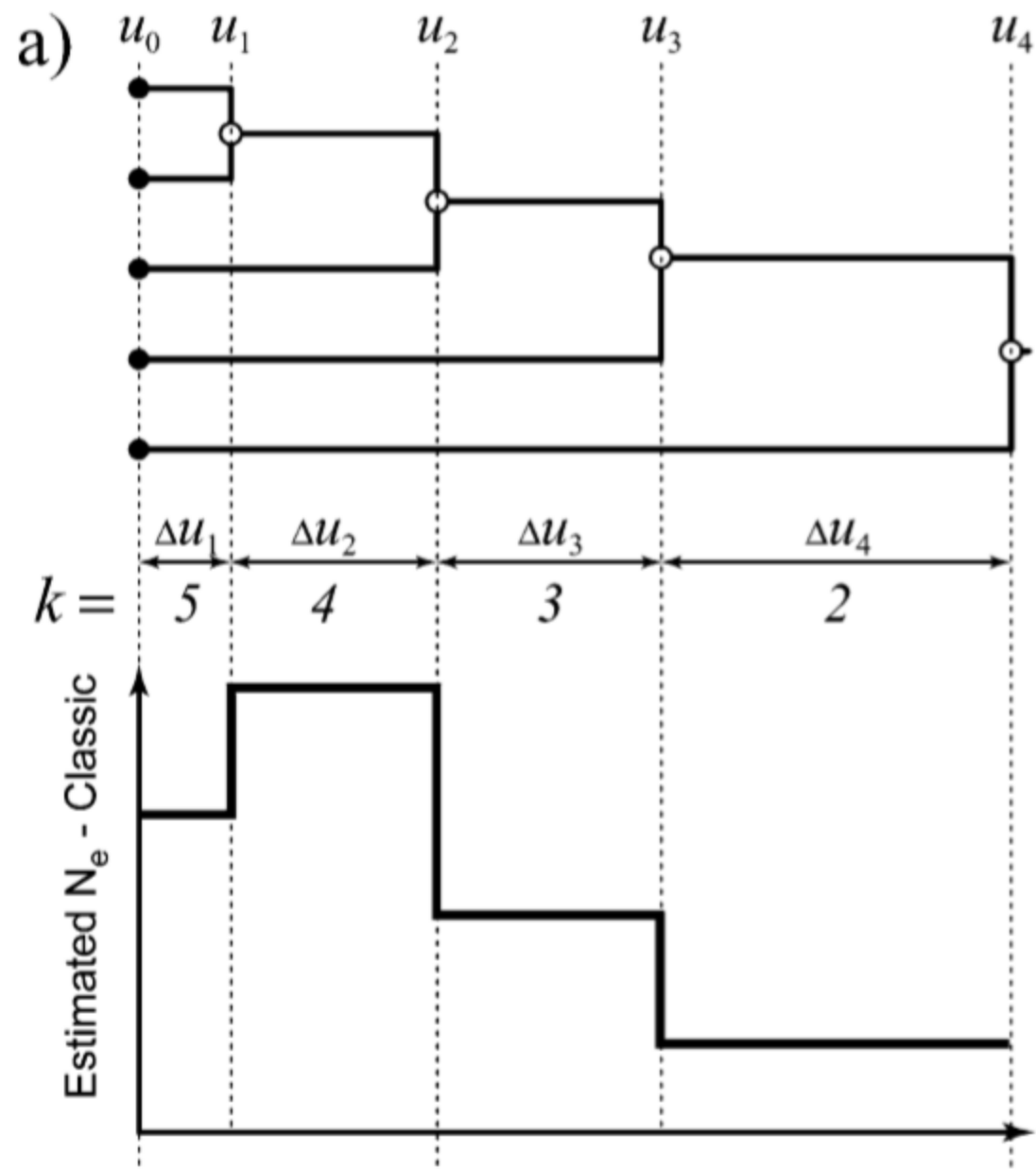
$$\Delta u_i = u_i - u_{i-1}.$$

The classic skyline plot

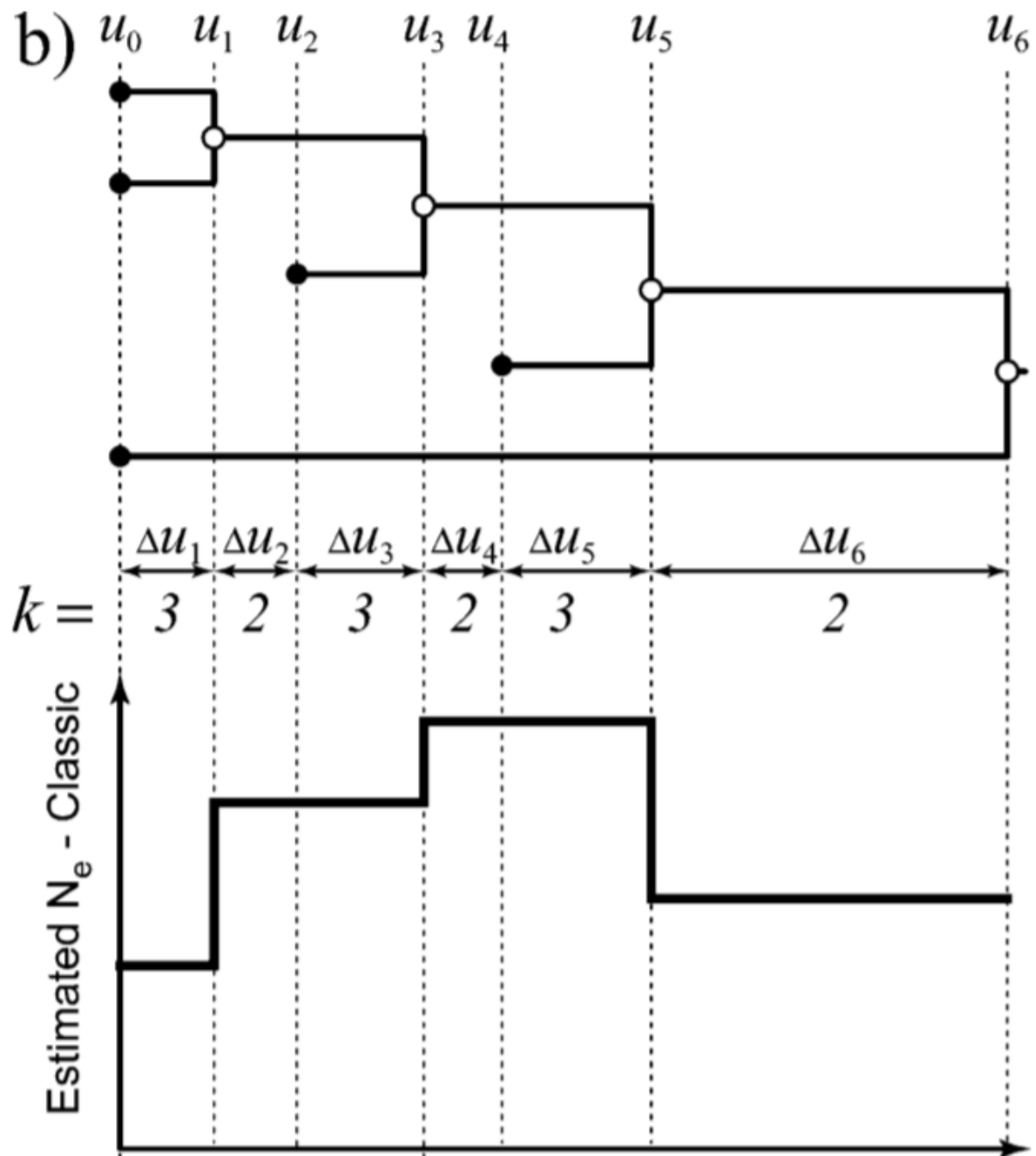


The classic skyline plot

- The number of lineages
- $K = \{ k_1, k_2, \dots, k_{n-1} \}$



- heterochronous genealogies have two types of intervals
- Coalescent intervals
- Sample intervals



The generalized skyline plot

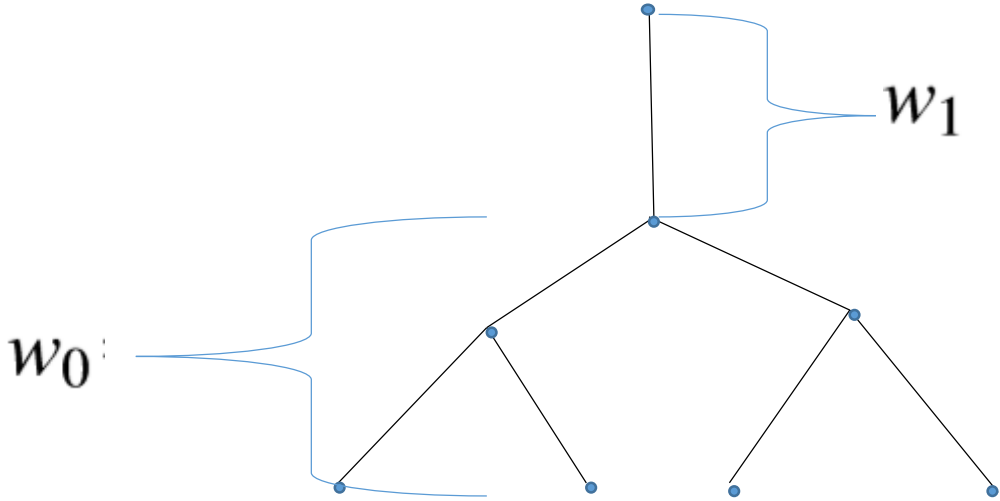
- ordered subset of group sizes

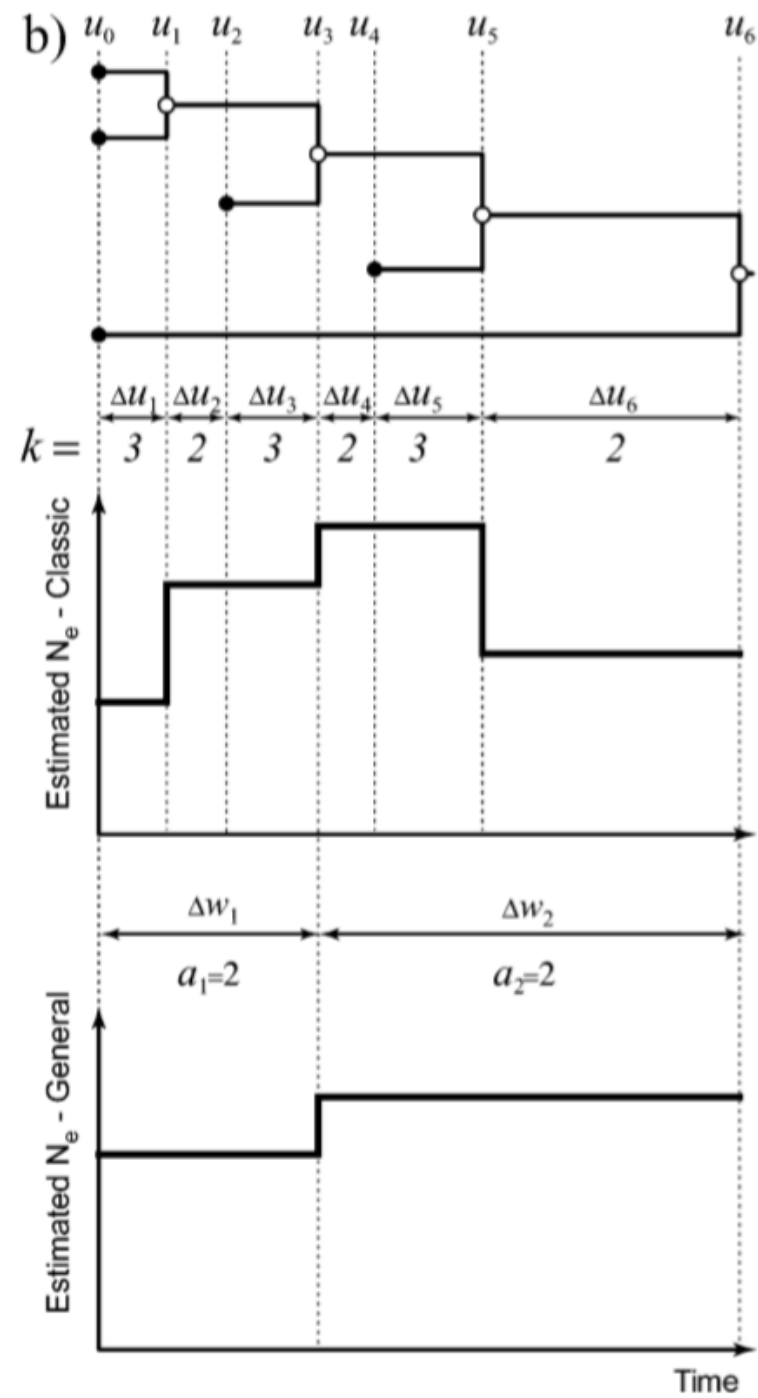
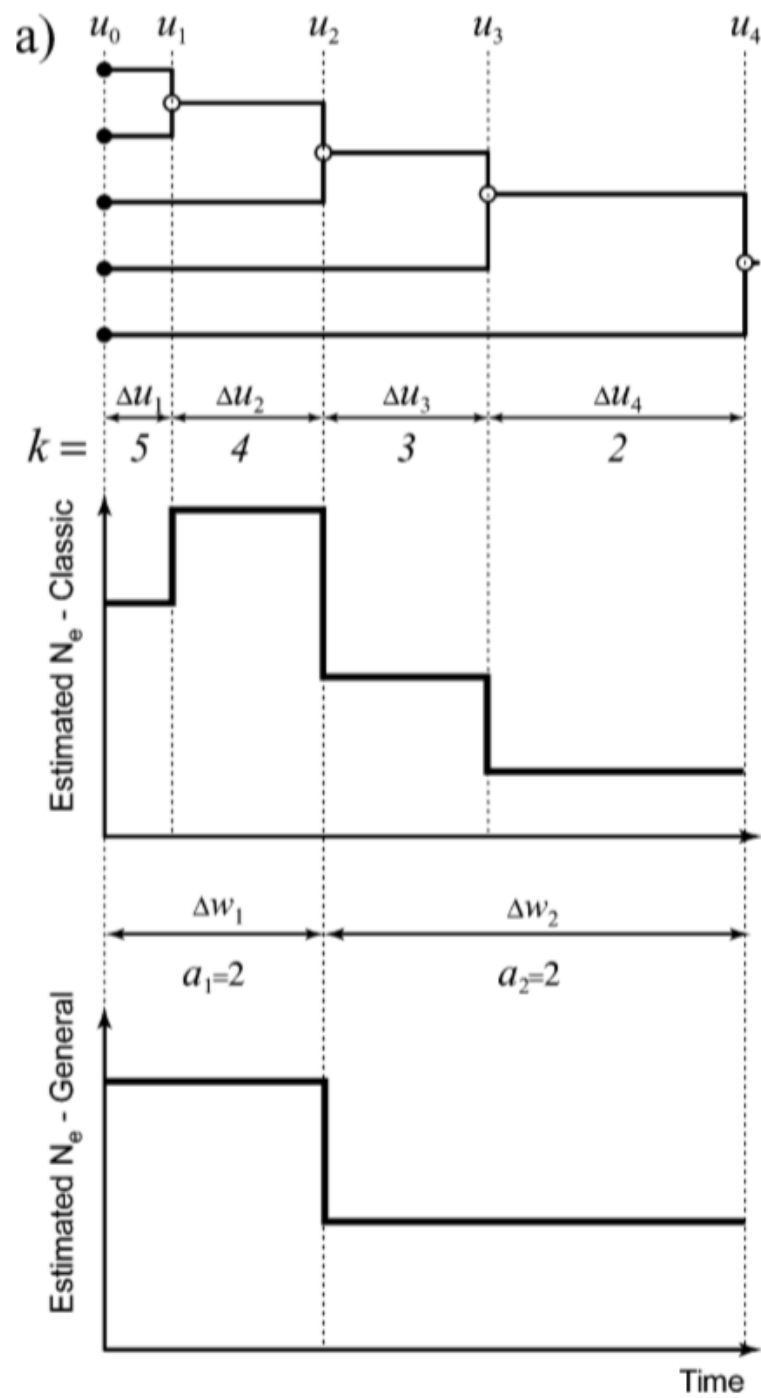
$$A = \{a_1, a_2, \dots, a_m\}$$

- the group times w

$$\Delta w_j = w_j - w_{j-1}$$

The generalized skyline plot





- The skyline plot typically produces “noisy” plots that display the stochastic variability inherent in the coalescent process.
- To reduce this noise, the “generalized skyline plot” was developed.

The Bayesian Skyline Plot Model

- represent the effective population size within each grouped interval

$$\Theta = \{\theta_1, \theta_2, \dots, \theta_m\}$$

The Bayesian Skyline Plot Model

- The vectors $\Theta = \{\theta_1, \theta_2, \dots, \theta_m\}$
- $A = \{a_1, a_2, \dots, a_m\}$
- genealogy (g)

$$\Theta_j, A_j, g_j$$

- the MCMC method coestimates the ancestral genealogy and parameters of the substitution process as well as the demographic parameters.

- <https://taming-the-beast.org/tutorials/Skyline-plots/Skyline-plots.pdf>

Thanks