

STATS 700-002 Class 2.

The coalescent

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Kingman, J. F. C. (1982). The coalescent. *Stochastic Processes and their Applications*, 13(3), 235-248.

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- ▶ What extensions can you envision?

Bibliography I

- Kingman, J. F. C. (1982a). The coalescent. *Stochastic Processes and their Applications*, 13(3):235–248.
- Kingman, J. F. C. (1982b). Exchangeability and the evolution of large populations. In Koch, G. and Spizzichino, F., editors, *Exchangeability in Probability and Statistics*, pages 97–112. North-Holland, Amsterdam.
- Kingman, J. F. C. (1982c). On the genealogy of large populations. *Journal of Applied Probability*, 19:27–43.
- Wakeley, J. (2009). *Coalescent Theory: An Introduction*. W. H. Freeman, New York.