Seth Temple
sdtemple@uw.edu

# Royal Pedigrees

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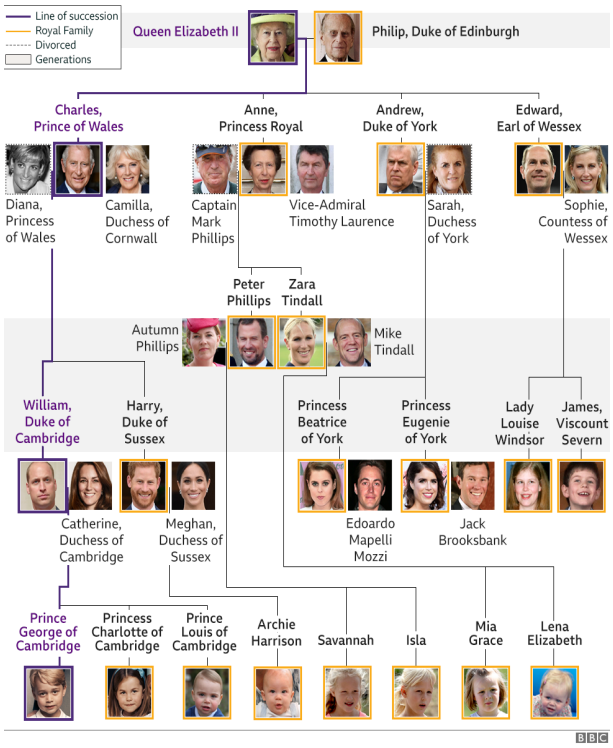
Let $M_A$ be the mother of $A$, $F_A$ be the father of $A$, $n(\cdot)$ be the number of meioses in a path, $\psi(\cdot,\cdot)$ be the kinship coefficient, and $f_A = \psi(M_A, F_A)$ be the inbreeding coefficient for $A$. Throughout the following exercises, we use the path-counting formula.

$$\sum_{A \in \mathcal{A}} \sum_{\mathcal{P}(A)} (1 + f_A)(1/2)^{n(\mathcal{P}(A))+1}$$

## 1 British Royal Family




1. Compute the kinship between Lady Louise Windsor and Prince George of Cambridge.

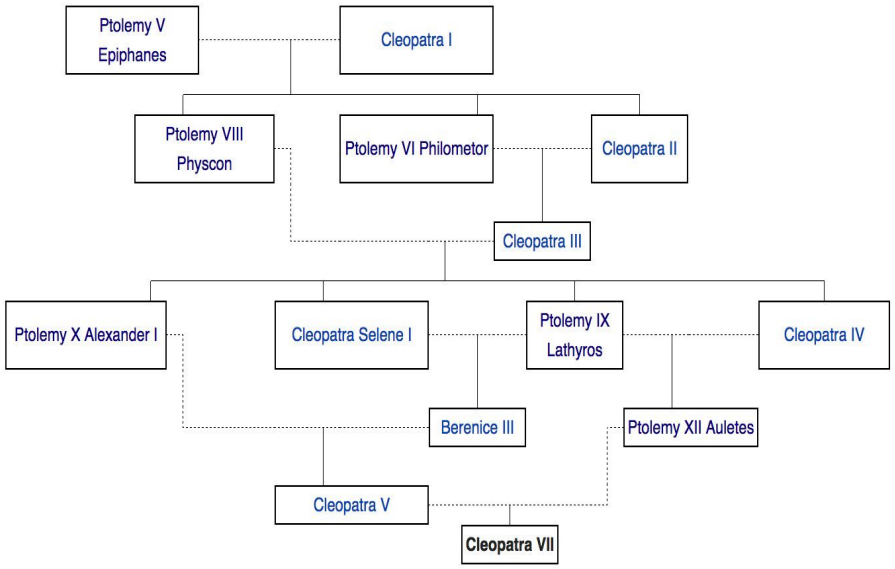
   (a) $2(1+0)(1/2)^{5+1} = 0.03125$. This is consistent with first cousins once removed.

2. Compute the kinship of Archie Harrison and Edward, Earl of Wessex.

   (a) $2(1+0)(1/2)^{4+1} = .0625$. This is consistent with a granduncle-grandnephew.

3. Compute the kinship of Lena Elizabeth and Charles, Prince of Wales.

   (a) $2(1+0)(1/2)^{4+1} = .0625$. This is consistent with a granduncle-grandniece.




# 2 Cleopatra of Egypt

1. Compute the inbreeding coefficient of Cleopatra III.

   (a) The kinship between Ptolemy VI Philometer and Cleopatra II is $2(1+0)(1/2)^{2+1} = 0.25$. This is consistent with siblings. Therefore, the inbreeding coefficient for Cleopatra III is 0.25.

2. Compute the inbreeding coefficient of Cleopatra IV.

   (a) The kinship between Ptolemy VIII Physcon and Cleopatra III is

   $$2(2)(1+0)(1/2)^{3+1} = 0.25.$$

   This is an uncle-niece pair twice over. Therefore, the inbreeding coefficient for Cleopatra IV is 0.25.

3. Compute the inbreeding coefficient of Berenice III.

   (a) The kinship between Cleopatra Selene I and Ptolemy IX Lathyros is

   $$1(1)(1+0)(1/2)^{2+1} + 1(1)(1+0.25)(1/2)^{2+1} + 2(4)(1+0)(1/2)^{5+1} = 0.40625.$$

   The first term is for the path through the non-inbred Ptolemy VIII Physcon, the second term is for the path through the inbred Cleopatra III, and the third term is for paths through the non-inbred founders. Therefore, the inbreeding coefficient for Bernice III is 0.40625.