Question 1:  
a.  
Mean: 0.050366360906888966  
Variance: 0.010314441602725719  
Skewness: 0.12046167291008684  
Kurtosis (excess): 0.22908332509377516  
Mean diff = 0.0  
Variance diff = 0.0  
Skewness diff = 2.7755575615628914e-17  
Kurtosis diff = 0.0  
  
b.  
A Normal Distribution seems like the better choice to model it. The mean is 0.050, and the variance is 0.010, which are within normal ranges. The skewness is 0.120, indicating that the data is almost perfectly symmetric, with only a very slight rightward lean. The excess kurtosis is 0.229, showing that the tails of the data are slightly heavier than those of a perfect Normal Distribution but still fairly close. Since these values align closely with the properties of a Normal Distribution, it seems like a more natural fit than a T-Distribution, which is used for data with much heavier tails.  
  
c.  
AIC and BIC Comparison:  
Normal Distribution: AIC = -1731.60, BIC = -1721.78  
T-Distribution: AIC = -1731.53, BIC = -1716.81  
Based on AIC, Normal Distribution fits better.  
Based on BIC, Normal Distribution fits better.  
  
  
  
  
Question 6：  
c.  
Frobenius Norm (Cholesky): 0.02179562160305022  
Frobenius Norm (PCA): 0.08316923525944199  
  
The Frobenius norm of the Cholesky method is small (0.0218):  
This indicates that the covariance matrix simulated by the Cholesky method is very close to the original covariance matrix.  
The Cholesky method retains the complete structure of the original covariance matrix and therefore the simulation results are more accurate.  
  
The Frobenius norm of the PCA method is larger (0.0832):  
This indicates that the covariance matrix simulated by the PCA method is more different from the original covariance matrix.  
The PCA method loses some information by dimensionality reduction (only 75% of the variance is retained), so the simulation results are more different from the original matrix.  
  
E.  
Cholesky Simulation Time: 0.1133 seconds  
PCA Simulation Time: 0.0155 seconds  
Cholesky Method took significantly more time than the PCA Method. This difference in time is expected because the Cholesky method requires performing matrix decompositions (Cholesky decomposition) and generating correlated random samples, which can be computationally expensive, especially as the number of components or the matrix size increases. The PCA method typically involves dimensionality reduction, which is less computationally demanding.  
  
F.  
The Cholesky simulation is more accurate in preserving the structure of the original covariance matrix, but it requires more computational effort.  
The PCA simulation is faster but loses some of the covariance structure due to dimensionality reduction, leading to less accurate results in terms of matching the original matrix.