Solutions to exercises in MATLAB Handout # 1

As on the handout, MATLAB commands are in bold type.

1.-3. Obvious from screen.

4. The calculations are executed as follows:
   
   ```matlab
   h=ones(5,1);
   H=eye(5)-h*inv(h'*h)*h';
   H=H-H'
   H*H-H
   ```

   At first glance the last calculation does not appear to yield zero, but note that the matrix is
   scaled by $1.0e-015$ that is $10^{-15}$. So the result is effectively zero. This is due to rounding
   in the $H^2$ calculation.

5. Given the structure of $H$, it has rank equal to four. Therefore, as it is idempotent, it has four
   eigenvalues of one and one of zero. The eigenvalues can be calculated as follows: `eig(H)`.

6. The trace equals the sum of the eigenvalues which in this case is four. The trace is calculated
   as follows: `trace(H)`.

7. Notice that the reinitialization of the seed in (b) means that $C$ and $D$ are equal in case (b)
   but not in case (a).

8. `5*ones(3,2)+2*randn(3,2)`.

9. A matrix of the dimension of $A$ whose elements are random draws from a standard normal
   distribution.

10. Recall that the orthogonal matrix of eigenvectors can be used to diagonalize $A$ and so the
    calculations are as follows. $A=[1 \ 2; 2 \ 1]$; $[F,L]=eig(A)$; $F'*AF$. Note that $F'AF = L$.

11. Create the function m-file LS.m as follows: $x=LS(A,b); x=inv(A'*A)*A'*b$; To verify
    that the least squares error is in the left null space of $A$, the calculation is: $(A*x-b)^*A$.
    Notice again that the answer is not exactly zero due to rounding but is obviously effectively
    zero.