Q1. $T(n) = \sum_{i=1}^{n} \sum_{j=1}^{n} 1$

$= \sum_{i=1}^{n} n \Rightarrow n \sum_{i=1}^{n} 1 \Rightarrow n \cdot n = n^2$

$T(n) = O(n^2)$

Q3. Big-O (upper bound) $= O(n^2)$

Big-Ω (lower bound) $= \Omega(n^2)$

Big-Θ $= \Theta(n^2)$

Q5. No, it will not effect the overall time complexity and it will still be $O(n^2)$ but function will take slightly longer to run due to extra operation.

Q4) To find "no", lets zoom in on the plot and check for any significant derivation where the timing data starts to behave differently from the Quadratic polynomial. By zooming in on the plot for n values between 0 and 100, we can observe that the runtime and polynomial fit follow a consistent quadratic trend in this range There doesn't appear to be significant deviation from the trend, so n_0 the value where the polynomial no longer holds is not visible in this window.

Q4) Adding the line y = i + j introduce an additional constant - time operation in the innermost loop. Since the number of iterations is still n power 2 this change does not affect the asymptotic complexity, but it does increase the runtime, but the overall complexity remains O(n power 2).