(1) Let $X_1, \ldots, X_n$ be a iid random sample from a distribution whose mean is $\mu_1$ and whose known variance is $\sigma_1^2$. Let $Y_1, \ldots, Y_m$ be a iid random sample from a distribution whose mean is $\mu_2$ and whose known variance is $\sigma_2^2$. Assume that $Y_i$ and $X_j$ are independent for all $i$ and $j$. Create a $\gamma$-coefficient confidence interval for the differences between the unknown means of the two distributions namely, $\mu_1 - \mu_2$.

(2) Let $X_1, \ldots, X_n$ be a iid random sample from a distribution whose mean is $\mu_1$ and whose unknown variance is $\sigma_1^2$. Let $Y_1, \ldots, Y_m$ be a iid random sample from a distribution whose mean is $\mu_2$ and whose unknown variance is $\sigma_2^2$. Assume that $Y_i$ and $X_j$ are independent for all $i$ and $j$. Create a $\gamma$-coefficient confidence interval for the differences between the unknown means of the two distributions namely, $\mu_1 - \mu_2$.

(3) Let $X_1, \ldots, X_n$ be a iid random sample from a distribution whose mean is $\mu_1$ and whose unknown variance is $\sigma$. Let $Y_1, \ldots, Y_m$ be a iid random sample from a distribution whose mean is $\mu_2$ and whose unknown variance is $\sigma$. Assume that $Y_i$ and $X_j$ are independent for all $i$ and $j$. Create a $\gamma$-coefficient confidence interval for the differences between the unknown means of the two distributions namely, $\mu_1 - \mu_2$. **Hint:** Estimate $\sigma$ with the pooled sample variance i.e., \[ \frac{(n-1)S_1^2 + (m-1)S_2^2}{n+m-2}. \]

(4) Let $X$ and $Y$ be two independent random variables with Bernoulli distributions $B(1, p_1)$ and $B(1, p_2)$, respectively. We want to find a confidence interval for the difference $p_1 - p_2$. Let $X_1, \ldots, X_n$ be an iid random sample from the distribution of $X$ and $Y_1, \ldots, Y_m$ be a iid random sample from a distribution of $Y$. Let $X$ and $Y$ be independent.

(5) Let $X_1, \ldots, X_n$ be a random sample from $N(\mu, \sigma^2)$, where both parameters $\mu$ and $\sigma^2$ are unknown. Obtain a $\gamma$-coefficient confidence interval for $\sigma^2$. **Hint:** Remember that $(n-1)S^2/\sigma^2 \sim \chi^2(n-1)$. 

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(6) Let $X_1, ..., X_n$ and $Y_1, ..., Y_m$ be two independent random samples from the respective normal distributions $N(\mu_1, \sigma_1^2)$ and $N(\mu_2, \sigma_2^2)$, where the four parameters are unknown. Construct a $\gamma$–coefficient confidence interval for the ratio of the variances namely, $\frac{\sigma_1^2}{\sigma_2^2}$.

**Hint:** Remember that $\frac{S_1^2}{\sigma_1^2}$ follows an $F$ distribution with degrees of freedom $n - 1$ and $m - 1$ respectively.

(7) Let $X_1, ..., X_n \sim N(\theta, \sigma^2)$. Assume that $\sigma^2$ is known. Suppose that we take a prior $\theta \sim N(a, b^2)$. Find $C = (c, d)$ such that $Pr(\theta \in C | X) = 0.95$.