1. a) N_1 is binomial $\sim B(n,p)$
so, $E(N_1) = np, \mathrm{Var}(N_1) = np(1-p)$
thus: $E(\hat{p}) = np/n = p$
$\mathrm{Var}(\hat{p}) = np(1-p)/n^2 = p(1-p)/n$
According to Central Limit Theorem, as n is large enough, the probability distribution of $\hat{p}$ will be normal.

b) $E(\hat{p}) = 70/100 = .7$
The CI is $.7 \pm z_{.05/2}\sigma_{\hat{p}} = (.61, .79)$

c) $L = 0.04$
$n \geq \frac{4Z^2_{\alpha/2}pq}{L^2}$
$p = q = .5$ maximizes the right hand side, so
$n = 2400$

Note: For those considered $L = 0.04p$, $n = 9600$.

2. a) $z = s - 6 = \sum\limits_{i=1} 12u_i - 6$ where $u_i \sim U(0,1)$ and independent.
so,
$\mu_z = \mu_s - 6 = 12\mu_U - 6 = 12 * 1/2 - 6 = 6 - 6 = 0$
$\sigma^2_z = \sigma^2_s = 12 * \sigma^2_U = 12 * 1/12 = 1$

b) Step 1: Generate 12 Us, Calc. Z, repeat m times
Step 2: Calc. Y from the m Zs
Step 3: If not enough Ys, go to step 1 else stop

c) Since Z_i is **symmertrically** distributed around a zero mean, $E(Z_i^3) = 0$.
$E(Y) = E(\sum Z_i^3) = \sum E(Z_i^3) = \sum 0 = 0$.
Note: For those who considered $E(Z^3) = E(Z)^3$, you were wrong and couldnot get credits from this part.

The standard deviation of Y will be $\sqrt{m}\sqrt{\mathrm{Var}(Z_1^3)}$. So it is positive relative to $\sqrt{m}$.

3. a) Since X is normal distributed with unknown variance, we should use t statistic.

	H_0 true	H_0 false
Accept H_0		type II error β
Reject H_0	type I error α	

b) $H_a : \mu < 100{,}000$
Reject H_0 when $|t| \leq |t_{\alpha,n-1}|$
$t = \frac{\bar{X}-\mu_0}{s/\sqrt{n}} = -2.17$
$t_{0.01,16} = -2.583$
So, cannot reject H_0.

c) There are not enough statistical evidence to accuse the manufactors of false advertising.

d) $P = t(-2.17) \doteq .023$
P-Value means the value of α at which level we would just reject the hypothesis.
When we increase the sample size, the P-value will be decreased.