1. $528 \pm (1.65 \times 90/\sqrt{150})$, that is, 515.88 to 540.12.

2a) $0.36 \pm (1.44 \times \sqrt{0.25/500})$, that is, 32.78% to 39.22%.
   b) $0.36 \pm (1.44 \times \sqrt{0.36 \times 0.64/\sqrt{500}})$, that is, 32.91% to 39.09%.

3a) (i) (b) (ii)
   c) You expect 20% of the sampled cars to be over 5 years old. The standard error is
   
   $$\frac{\sqrt{0.2 \times 0.8}}{\sqrt{500}} \sqrt{3500/3999} = 1.67\%$$
   
   So $z = 1.8$ and the chance is about 3.6%.
   d) Now $z$ is about $-0.67$, so the answer is $20\% - (0.67 \times 1.67)\% = 18.88\%$.

4a) (i) (b) (ii)
   c) (ii). If you draw the normal curve with mean 2.2 and SD 2, then values that are more than 1.1 SDs below the mean are negative. But household size is a positive variable. So the distribution of the household sizes in the sample cannot be normal. The large SD is probably coming from a long right hand tail.
   d) No. The distribution of a large simple random sample looks like the distribution of the population – that was the reason for taking the sample in the first place. The sample is far from normal. So the best guess is that the population is far from normal too.
   e) (i). The confidence interval is constructed using the probability histogram of the sample mean, that is, the curve that shows the chances of how the sample mean could have turned out. The sample size is large. So by the Central Limit Theorem, this probability histogram will be approximately normal, no matter what the shape of the distribution of the population. The interval is 2.09 to 2.31.

5a) Let $G$ be the number of gold coins in the box. The null hypothesis says that $G = 5$. The alternative hypothesis says that $G \leq 5$.
   b) $\{0, 1\}$
   c) Use the hypergeometric ($N = 10, G = 5, n = 5$) distribution to find the chance of 0, or 1 gold coins. The answer is $0.003968 + 0.09921 = 0.1032$.
   d) Same as (c) by definition.
   e) Change $G$ to 2 in part c). The answer is $0.2222 + 0.5555 = 0.7777$.
   f) $1 - 0.7777 = 0.2223$.
   g) The closer the alternative gets to $G = 5$, the smaller the power will be, and greater the chance of the Type II error.

6. The chance of Type I error is the chance of getting at least one pocket marked 36–38 in 3
spins of a fair wheel. The chance is $1 - (35/38)^3 = 0.2186$. So the answer is $0.2186 \times 60 = 13$ approximately.

7. The significance level is the chance of Type I error. If the null hypothesis is true, the number of tests that conclude “alternative” is binomial with $n = 1000$ and $p = 0.05$. So the expected number is 50 and the standard error is $\sqrt{1000 \times 0.05 \times 0.95} = 6.89$.

8a) Let $p$ be the chance of getting “0.” The null says that $p = 0.1$. The alternative says that $p \leq 0.1$. (It is also fine to say $p < 0.1$.)

Let $X$ be the number of 0’s in 5000 trials. Under the null hypothesis, $X$ has the binomial distribution with $n = 5000$ and $p = 0.1$. This is approximately normal with expected value 500 and SE 21.21. Use $z = -2.05$. The rejection region of the test is: $X \leq 456$.

b) Now the distribution of $X$ is binomial with $n = 5000$ and $p = 0.025$. This is approximately normal with expected value 125 and SE 11.04. So the chance that $X \leq 456$ is almost 1. So the power is very close to 100%. 