

# MATH 308 Assignment 3

## Exercises 1.11

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**2**

**a)**

Observational study.

**b)**

No, because it is possible that people without dementia are predisposed to drinking alcohol.

**3**

**a)**

Observational study.

**b)**

No, because it is likely that students who already use marijuana would be interested in listening to music that had references to marijuana.

**c)**

No, because the study sample was not collected in a controlled, randomized fashion. Further, it excludes students who are not in high school.

**5**

Number of unique subsets of size  $N$  is  $\binom{N}{n}$ .  
The number of unique subsets that include a given

individual is  $\binom{N-1}{n-1}$ .  
 $\therefore$  Required probability

$$\begin{aligned} &= \binom{N-1}{n-1} / \binom{N}{n} \\ &= \frac{(N-1)!}{(N-n)!(n-1)!} \times \frac{(N-n)!n!}{N!} \\ &= \frac{(N-1)!}{N!} \times \frac{n!}{(n-1)!} \\ &= \frac{n}{N} \quad \square \end{aligned}$$

This formula does not change with the individual. Therefore, by symmetry, every person has an equal chance of being in the group.  $\square$

**6**

**a)**

From (5), with  $N = 10^8$  and  $n = 10^3$ , required probability  $p = n/N = 10^{-5}$ .

**b)**

Probability of not being in any of 2000 independently chosen samples =  $(1 - p)^{2000} \approx 98\%$ .

**c)**

A half-chance of being in at least one sample implies a half-chance of being in no samples. So, if  $t$  samples

are chosen,

$$\begin{aligned} & q^t = 0.5 \\ \Rightarrow & t \log q = \log 0.5 \\ \Rightarrow & t = \frac{\log 0.5}{\log(1 - 10^{-5})} \\ & = 69315 \end{aligned}$$