

### AML5103 | Applied Probability and Statistics | Problem Set-3

1. A salesman has scheduled two appointments to sell software, one in the morning and another one in the afternoon. There are two software editions available: the base edition costing Rs. 5000 and the premium edition costing Rs. 10000. His morning appointments typically lead to a sale with a 30% chance while the afternoon ones typically lead to a sale with a 60% chance independent of what happened in the morning. If the morning appointment ends up in sale, the salesman has a 70% chance of selling the premium edition and if the afternoon appointment ends up in a sale, he is equally likely to sell either of the editions. Let  $X$  be the random variable representing the total Rupee value of sales on a random day. What are the different values that  $X$  can take? Calculate the corresponding probabilities using (i) a pen & paper approach (ii) a simulation approach based on the code template below. Upload a snapshot of your code clearly showing the output:

```
# Sampling space for appointment success (0 corresponds to no sale, 1 corresponds to a sale)
s_appointment = ?

# Appointment success and failure probabilities
p_morning = ? # Success probability of sales in morning
p_afternoon = ? # Success probability of sales in afternoon
p_appointment = matrix(nrow = 2, ncol = 2, c(1-p_morning, ?, ?, ?), byrow = TRUE)

# Sampling space for software type
s_software = c(?, ?)

# Software type probabilities
p_software = matrix(?, ?, ?, byrow = TRUE)

# Function that simulates one trial of the random experiment which is
# what the salesman earns on a random day
salesResult = function(){
  result = numeric(2)
  # Simulate whether sales happen in morning and afternoon appointments
  for (j in c(1:2)){
    result[j] = sample(?, size = 1, replace = TRUE, prob = p_appointment[?, ?])
  }
  earnings = ifelse(result[1] == 1, sample(?, size = 1, replace = TRUE, prob = p_software[?, ?]), 0) + ifelse(result[2] == 1, ?, ?)
  return(?)
}

# Number of simulations
nsimulations = 1e5
simulatedData = replicate(nsimulations, ?)

# Probability that the salesman earns Rs 5000
mean(simulatedData == ?)
```