1. a. The probability is \(\int_{60}^{\infty} \frac{1}{30} e^{-x/30} \, dx = -e^{-x/30}\bigg|_{x=60}^{\infty} = e^{-2} = .1353\).

b. Since the average is \(1/\lambda = 30\) minutes, then the variance is \(1/\lambda^2 = 900\), so the standard deviation is \(\sqrt{1/\lambda^2} = 30\) minutes.

2. Let \(X\) be the time (in minutes) until the next dessert; let \(Y\) be the time (in minutes) until the next appetizer. The probability is \(P(X < Y) = \int_{0}^{\infty} \int_{x}^{\infty} \frac{1}{3} e^{-x/3} \frac{1}{2} e^{-y/2} \, dy \, dx = \int_{0}^{\infty} -\frac{1}{3} e^{-x/3} e^{-y/2} \bigg|_{y=x}^{\infty} \, dx = \int_{0}^{\infty} \frac{1}{3} e^{-5x/6} \, dx = -\frac{1}{3} \frac{6}{5} e^{-5x/6} \bigg|_{x=0}^{\infty} = 2/5\).

3. Using the CDF of \(X\), we have \(P(X \leq 20) = F_X(20) = 1 - e^{-20/10} = 1 - e^{-2}\). Similarly \(P(Y \leq 20) = 1 - e^{-1}\) and \(P(Z \leq 20) = 1 - e^{-1}\). Since the \(X, Y, Z\) are independent, then \(P(\max(X, Y, Z)) = P(X \leq 20)P(Y \leq 20)P(Z \leq 20) = (1 - e^{-2})^3 = 0.2526\).

4. The company expects to pay \(\int_{0}^{3} (0) \frac{1}{15} e^{-x/1.5} \, dx + \int_{3}^{\infty} (72)(100)(x - 3) \frac{1}{15} e^{-x/1.5} \, dx = (72)(100) \int_{0}^{\infty} x \frac{1}{15} e^{-(x+3)/1.5} \, dx\). Notice \(\int_{0}^{\infty} x \frac{1}{15} e^{-x/1.5} \, dx\) is the expected value of \(X\), i.e., is 1.5. So the company expects to pay \((72)(100)(e^{-2})(1.5) = 1461.62\) dollars.

5. The probability is \(\int_{0}^{10} \int_{x}^{\infty} \left(\frac{1}{10}\right) \frac{1}{5} e^{-y/5} \, dy \, dx = \int_{0}^{10} \left(\frac{1}{10}\right) \frac{1}{5} e^{-y/5} \bigg|_{y=x}^{\infty} \, dx = \int_{0}^{10} \frac{1}{10} e^{-x/5} \, dx = \frac{1}{2} \int_{0}^{10} \frac{1}{5} e^{-x/5} \, dx\), but the last integral is just the CDF of an exponential with average of 5, evaluated at 10. So the overall probability is \(\frac{1}{2}(1 - e^{-10/5}) = \frac{1}{2}(1 - e^{-2}) = 0.4323\).