

Practical Data Science/Analytics (Probability Distributions)

Write R Scripts or use R to perform any mathematical operations while solving the following problems.

Problem 1: Ticket Issue for high speed

Speeds of cars on a particular stretch of highway are normally distributed with a mean of 112 km/h and a standard deviation of 7 km/h. The speed limit on this highway is 110 km/h. Police allow motorists a 10% leeway before issuing a ticket. If 250 cars pass by, how many would you expect to be ticketed for speeding?

Problem 2: Warranty & Extended Warranty on Music Players

A manufacturer of personal music players has determined that the mean life of the players is 32.4 months, with a standard deviation of 6.3 months.

- If 10 000 personal music players are sold, how many could the manufacturer expect to be returned under warranty?
- Determine what length of warranty to offer if they don't want to replace any more than 1.5% of the players.
- The manufacturer wants to offer the option of purchasing an extended warranty. What length of extended warranty should they offer if they want to replace no more than 20% of the players?

Problem 3: Life Time of Tires

A manufacturer has found that the life of its tires is normally distributed with a mean of 55 000 km and a standard deviation of 8000 km.

- Find the percentage of tires that last longer than 53 000 km, to the nearest hundredth.
- If 45 000 tires are produced, how many will last between 40 000 km and 65 000 km?

Problem 4: Airline Overbooking

Suppose that past experience shows that about 10% of passengers who are scheduled to take a particular flight fail to show up. For this reason, airlines sometimes overbook flights, selling more tickets than they have seats, with the expectation that they will have some no shows. Suppose an airline used a small jet with seating for 30 passengers on a regional route and assume that passengers are independent of each other in whether they show up for the flight. Suppose that the airline consistently sells 32 tickets for every one of these flights.

- On average, how many passengers will be on each flight?

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- b. How often will they have enough seats for all of the passengers who show up for the flight?

Problem 5: Owner Occupied Housing Units

In the 2010 US Census, we learn that 65% of all housing units are owner-occupied while the rest are rented. If we take a random sample of 20 housing units, find the probability that:

- a. Exactly 15 of them are owner-occupied.
- b. 19 or more of them are owner-occupied.

Problem 6: Poisson Distribution

- a. If you have beam collisions at a rate of 1 MHz on average, and they occur in 20 ns time intervals, then use the Poisson probability formula to determine a) the probability of seeing at least one collision in a particular time interval, and b) the average rate (in Hz) for seeing two collisions or more at a time.
- b. Your new particle detector turns out to be not that efficient: it only gives you a “hit” one out of every five times a particle passes through it. If 1000 particles pass through it, what is the mean and rms spread of the number of hits you might observe?