# Binomial Distribution

7 8 9 10 **11** 12

TI-30XPlus MathPrint™ | Worksheet | 15 min

## Calculator Skills:

- Binomial Distribution
- Generate a list (binompdf)

**Formula**:

$$P(x) = {}^{n}C_{x}(p)^{x}(1-p)^{n-x}$$

### Question: 1.

Suppose 10% of the world's population have blonde hair. In a classroom with 25 students, what is the probability:

i) Exactly 2 students will have blonde hair?

ii) No students will have blonde hair?

iii) There will be 3 or fewer students with blonde hair?

### Question: 2.

Cars passing through a controlled intersection are categorised as either: sedan (45%), SUV (30%), station-wagon (10%), utility (9%) or couple (6%).

i) If 30 cars pass through the intersection in a single light change, what is the probability that 6 of them will be station-wagons?

ii) If 24 cars pass through the intersection in a single light change, what is the probability that half of them will be SUVs?

iii) In one light change consisting of 22 cars Alex noticed he noticed he was driving the only station-wagon passing through the intersection, what is the likelihood of this happening?

iv) Emily noticed that in one light change 26 cars passed through the intersection and they were all either sedans or SUVs. What is the probability of such an event?

### Question: 3.

Mobile phone numbers in Australia consist of 10 digits. The first two are 04, this leaves 8 other digits, assuming the remaining digits are random and independent, calculate each of the following probabilities the remaining 8 digits:

i) Contain at least 2 zeros.

ii) Consist of only 0's and 4's.

iii) Consist of only even numbered digits.

iv) Do not contain an 8.

v) Add up to an even number.

**Answers on Page 2**



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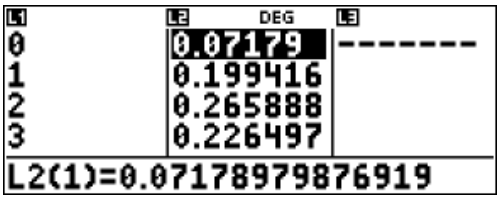
## Question: 1.

n = 25, p = 0.1.

Note that all the probabilities can be generated and stored in a list or calculated individually.




i) x = 2 ∴ P(2) = 0.2659

ii) x = 0 ∴ P(0) = 0.0718

iii) x = 0, 1, 2 or 3 => 0.0718 + 0.1994 + 0.2659 + 0.2265 = 0.7636

Note: Part (iii) can also be calculated using binomialcdf (cumulative) with x = 3.

## Question: 2.

Whilst there are multiple car categories, each question can be turned into 'binomial' by considering 'favourable' and 'not favourable' outcomes.

i) Wagon: p = 0.1. n = 30, x = 6: Pr(x = 6) = 0.0474

ii) SUV p = 0.3. n = 24, x = 12: Pr(x = 12) = 0.0199

iii) Wagon p = 0.1. n = 22, x = 6: Pr(x = 1) = 0.2407

iv) Wagon or SUV p = 0.75, n = 26, x = 26 Pr(x = 26) = 0.0006

## Question: 3.

The probability of a specific digit is 1/10 as there are 10 different digits: 0, 1, 2, … 9.

i) At least 2 zeros: p = 0.1. n = 8, x ≥ 2 , Pr(X≥2) = 1 – Pr(X≤1) = 0.1869

ii) Zero or Four: p = 0.2. n = 8, x = 8, Pr(x = 8) = $2.56 \times 10^{-6}$.

Putting this result into perspective, of the more than 10 million phone numbers in Australia, you would expect approximately 25 people a mobile number consisting only of 0's and 4's. However, there are many people that request 'specific' numbers, so it is not completely random!

iii) Even digits: p = 0.5. n = 8, x = 8. Pr(x = 8) = 0.0039

iv) No 8's: p = 0.9, n = 8, x = 8, Pr(x =8) = 0.4305

v) If the digits add up to an even number then they may consist of either 0, 2, 4, 6 or 8 odd digits.
0 Odd digits: p = 0.5, n = 8, x = 0, Pr(x = 0) = 0.0039

2 Odd digits: p = 0.5, n = 8, x = 2 Pr(x = 2) = 0.1094

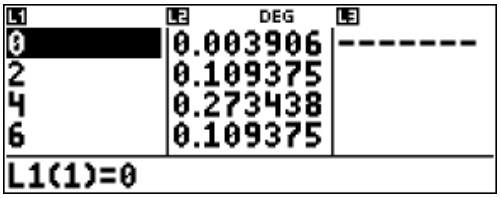
4 Odd digits: p = 0.5, n = 8, x = 4 Pr(x = 4) = 0.2734

6 odd digits: p = 0.5, n = 8, x = 6, Pr(x = 6) = 0.1094

8 odd digits: p = 0.5, n = 8, x = 8, Pr(x = 8) = 0.0039

Sum of these quantities: 0.5

Note: The list of probabilities can be calculated most efficiently using a list, then sum the list.



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