# Exercise Solutions

For questions 1 and 2, recall that, for offspring genotypes from a heterozygous cross:

Carrier = Aa with Pr(Aa) = ½

Unaffected = AA with Pr(AA) = ¼

Affected = aa with Pr(aa) = ¼

Consider a scenario with n=3 offspring.

## Question 1

What is the probability that all three offspring will be carriers?

$$
\begin{aligned}
P(Y_1 = 0, Y_2 = 3, Y_3 = 0) &= \frac{3!}{0!3!0!} p_1^0 p_2^3 p_3^0 \\
&= \frac{3 \cdot 2 \cdot 1}{3 \cdot 2 \cdot 1} (0.25)^0 (0.5)^3 (0.25)^0 \\
&= 0.125
\end{aligned}
$$

R code:

```
dmultinom(x=c(0, 3, 0), prob=c(0.25, 0.5, 0.25))
```

## Question 2

What is the probability that two offspring will be affected and one will be a carrier?

$$
\begin{aligned}
P(Y_1 = 0, Y_2 = 1, Y_3 = 2) &= \frac{3!}{0!1!2!} p_1^0 p_2^1 p_3^2 \\
&= \frac{3 \cdot 2 \cdot 1}{2 \cdot 1} (0.25)^0 (0.5)^1 (0.25)^2 \\
&= 0.09375
\end{aligned}
$$

R code:

```
dmultinom(x=c(0, 1, 2), prob=c(0.25, 0.5, 0.25))
```

# Exercises

For the following questions, calculate the specified probabilities for the standard Normal random variable $Z \sim N(0,1)$. You can use an online standard Normal CDF calculator.

## Question 3

$P(Z \leq 1.65)$ = **0.9505**

R code:

```
pnorm(1.65, mean = 0, sd = 1)
```

## Question 4

$P(Z \geq 0.5)$ = **0.3085**

R code:

```
1 - pnorm(0.5, mean = 0, sd = 1)
```

## Question 5

$P(-1.96 \leq Z \leq 1.96)$ = 0.975 – 0.025 = **0.95**

R code:

```
pnorm(1.96, mean = 0, sd = 1) - pnorm(-1.96, mean = 0, sd = 1)
```