3.17: **(a):** Let's consider the exam scores corresponding to integer z scores.

$z =$	-3	-2	-1	0	1	2	3
$x =$	52.38	60.82	69.26	77.70	86.14	94.58	103.02

There are 14 scores between 69.26 and 86.14. There are 19 scores between 60.82 and 94.58. There are 20 scores between 52.38 and 103.02.

$$\frac{14}{20} = 0.7 \approx 0.68$$

$$\frac{19}{20} = 0.95 = 0.95$$

$$\frac{20}{20} = 1.0 \approx 0.997$$

The exam scores closely match the 68-95-99.7 rule.

(b): Yeah. The normal curve matches closely to the histogram, and the Q–Q (quantile-quantile) plot looks nearly linear. Also the 68-95-99.7 analysis suggests normality.

3.18: **(a):** Let's consider the heights corresponding to integer z scores.

$z =$	-3	-2	-1	0	1	2	3
$x =$	47.78	52.36	56.94	61.52	66.1	70.68	75.26

There are 17 heights between 56.94 and 66.1. There are 19 heights between 52.36 and 70.68. There are 20 heights between 47.78 and 75.26.

$$\frac{17}{20} = 0.85$$

$$\frac{19}{20} = 0.95$$

$$\frac{20}{20} = 1.0$$

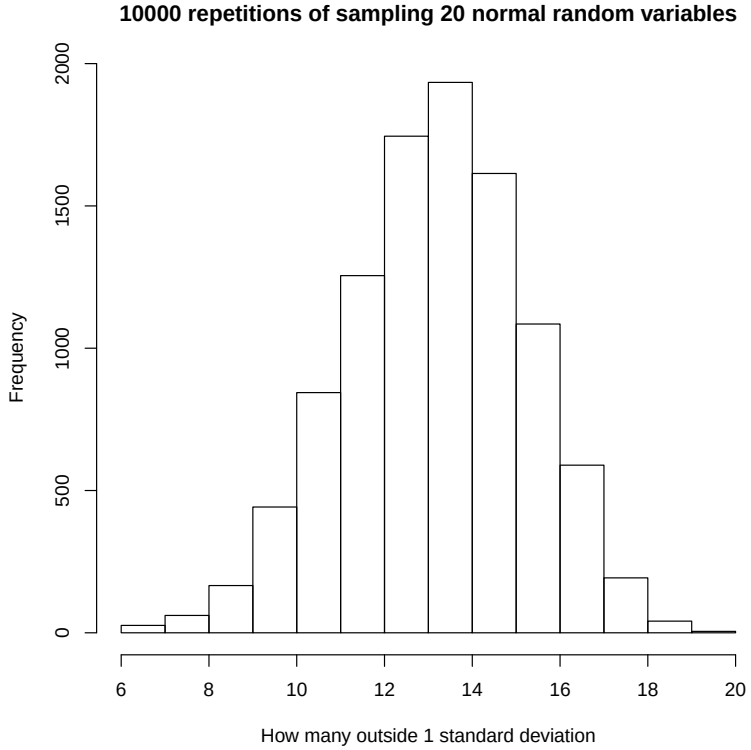
I'm not sure how closely we really expect such a small sample to match the 68-95-99.7 rule. Let's run some simulations.

In R, I can run the command `sum(abs(rnorm(20))<1)` to run a single simulation of drawing 20 normal random variable and counting how many are within 1 standard deviation. I've repeated this 10 times...

```
> sum(abs(rnorm(20))<1)
[1] 15
> sum(abs(rnorm(20))<1)
[1] 14
> sum(abs(rnorm(20))<1)
[1] 17
```

```
> sum(abs(rnorm(20))<1)
[1] 13
> sum(abs(rnorm(20))<1)
[1] 16
> sum(abs(rnorm(20))<1)
[1] 15
> sum(abs(rnorm(20))<1)
[1] 11
> sum(abs(rnorm(20))<1)
[1] 12
> sum(abs(rnorm(20))<1)
[1] 12
> sum(abs(rnorm(20))<1)
[1] 18
```

I can repeat this 10000 times, where each time I sample 20 random normal variables and count how many are outside 1 standard deviation from the mean.



So, getting 17 (out of 20) within 1 standard deviation (from the mean) seems uncommon but not rare when sampling from a normal distribution.

If you are interested, here is the code I ran in R:

```
counts = c()
for (i in seq(1,10000))
{
   counts = c(counts,sum(abs(rnorm(20))<1))
}
hist(counts,
     xlab='How many outside 1 standard deviation',
     main='10000 repetitions of sampling 20 normal random variables')
```

(b): These data seem like they could be from a normal distribution. There are hints that maybe these data come from a right-skew distribution, but with such a small sample size it is really hard to say anything definitive.