1.

True mean:

```
> mean(TenMileRace$net)
[1] 5599.065
```

Within the true mean: Yes, Not in the true mean: No

```
> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 31.351, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5097.791 5816.289
sample estimates:
mean of x
  5457.04
```

Yes

```
> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 28.002, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5326.224 6173.856
sample estimates:
mean of x
  5750.04

> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 26.421, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5225.356 6110.884
sample estimates:
mean of x
  5668.12
```

Yes Yes

```
> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 30.812, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5178.766 5922.354
sample estimates:
mean of x
  5550.56

> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 24.148, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5381.181 6386.979
sample estimates:
mean of x
  5884.08
```

Yes Yes

```
> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 25.262, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5204.383 6130.417
sample estimates:
mean of x
   5667.4

> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 33.226, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5627.558 6373.002
sample estimates:
mean of x
  6000.28
```

Yes No

```
> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 24.746, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5189.448 6133.832
sample estimates:
mean of x
  5661.64

> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 31.212, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5309.569 6061.471
sample estimates:
mean of x
  5685.52
```

```
> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 20.422, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5093.345 6238.575
sample estimates:
mean of x
  5665.96
```

Yes Yes Yes

```
> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 26.966, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5317.969 6199.471
sample estimates:
mean of x
  5758.72

> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 26.266, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5077.785 5943.815
sample estimates:
mean of x
   5510.8

> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 32.143, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 4974.028 5656.612
sample estimates:
mean of x
  5315.32
```

Yes Yes Yes

```
> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 43.801, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5334.11 5861.65
sample estimates:
mean of x
  5597.88

> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 30.605, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5394.876 6175.124
sample estimates:
mean of x
     5785

> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 29.062, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5294.867 6104.413
sample estimates:
mean of x
  5699.64

> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 30.563, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 4874.955 5581.045
sample estimates:
mean of x
     5228
```

Yes Yes Yes No

```
> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 33.052, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5312.719 6020.401
sample estimates:
mean of x
  5666.56

> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 31.789, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5298.663 6034.457
sample estimates:
mean of x
  5666.56

> t.test(TenMileRace$net[sample(1:8636, 25)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 25)]
t = 34.964, df = 24, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5277.413 5939.547
sample estimates:
mean of x
  5608.48
```

Yes Yes Yes

There are 18/20 random samples of size 25 from the population of net race time contained the true mean.

2.

```
> FemaleCats=filter(cats, Sex=="F")
> MaleCats=filter(cats, Sex=="M")
> t.test(FemaleCats$Bwt)

        One Sample t-test

data:  FemaleCats$Bwt
t = 59.041, df = 46, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 2.279129 2.440020
sample estimates:
mean of x
 2.359574
```

```
> t.test(FemaleCats$Hwt)

        One Sample t-test

data:  FemaleCats$Hwt
t = 46.467, df = 46, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 8.803502 9.600753
sample estimates:
mean of x
 9.202128
```

```
> t.test(MaleCats$Hwt)

        One Sample t-test

data:  MaleCats$Hwt
t = 43.864, df = 96, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 10.81030 11.83506
sample estimates:
mean of x
 11.32268

> t.test(MaleCats$Bwt)

        One Sample t-test

data:  MaleCats$Bwt
t = 61.097, df = 96, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 2.805781 2.994219
sample estimates:
mean of x
      2.9
```

Male cats' heart weights and body weights are much heavier than those of female cats.

3.

```
> t.test(TenMileRace$net[sample(1:8636, 30)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 30)]
t = 37.487, df = 29, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5066.528 5651.272
sample estimates:
mean of x
   5358.9
```

```
> t.test(TenMileRace$net[sample(1:8636, 230)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 230)]
t = 83.205, df = 229, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5315.824 5573.698
sample estimates:
mean of x
 5444.761

> t.test(TenMileRace$net[sample(1:8636, 430)])

        One Sample t-test

data:  TenMileRace$net[sample(1:8636, 430)]
t = 123.02, df = 429, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 5552.891 5733.216
sample estimates:
mean of x
 5643.053
```

As the sample size increases, the 95 percent confidence interval gets narrower.

4.

```
> confidence(survey$Age, 0.99)
We are 99 percent sure that the mean is between 19.28241 and 21.46662
```

```
confidence=function(data, conflevel){
  lowerbound = t.test(data, conf.level = conflevel)$conf.int[1]
  upperbound = t.test(data, conf.level = conflevel)$conf.int[2]
  CIsentence = cat("We are", conflevel*100, "percent sure that the mean is between", lowerbound, "and", upperbound,"\n")
  return(CIsentence)
}
```

5.

```
> confidence(survey$Age, 0.99, "student age", "years")
We are 99 percent sure that the mean student age is between 19.28241 and 21.46662 years
```

```
confidence=function(data, conflevel, meanOfWhat, unit){
  lowerbound = t.test(data, conf.level = conflevel)$conf.int[1]
  upperbound = t.test(data, conf.level = conflevel)$conf.int[2]
  CIsentence = cat("We are", conflevel*100, "percent sure that the mean ", meanOfWhat, " is between",
                   lowerbound, "and", upperbound, unit, "\n")
  return(CIsentence)
}
```

6.

```
> confidence(survey$Age, 0.90 , "student age", "years")
We are 90 percent sure that the mean student age is between 19.68004 and 21.06899 years

> confidence(survey$Age, 0.95 , "student age", "years")
We are 95 percent sure that the mean student age is between 19.546 and 21.20303 years

> confidence(survey$Age, , "student age", "years")
We are 95 percent sure that the mean student age is between 19.546 and 21.20303 years
```

```r
confidence=function(data, conflevel, meanOfWhat, unit){
  if(missing(conflevel)){
    conflevel = 0.95
  }
  lowerbound = t.test(data, conf.level = conflevel)$conf.int[1]
  upperbound = t.test(data, conf.level = conflevel)$conf.int[2]
  CIsentence = cat("We are", conflevel*100, "percent sure that the mean", meanOfWhat, "is between",
                   lowerbound, "and", upperbound, unit, "\n")
  return(CIsentence)
}
```