

1. Review of Inference

Extra R Practice

Complete the following questions using R/RStudio.

1. **Frame render time.** A game studio targets 60 FPS, i.e., and average frame render time of 16.67 ms. A tester records the render time (ms) for 12 frames on a new build, which gives the following render times (ms):

16.8 17.1 16.5 17.3 16.9 17.1
17.0 16.6 17.2 16.7 17.4 16.8

Is there evidence that the mean render time differs from the 16.67 ms target?

2. **Battery firmware.** A phone maker claims a firmware update pushes average screen-on time above 8 hours. Screen-on time (hours) is measured on 10 devices, giving the following data (in hours):

8.2 7.9 8.5 8.1 8.3
7.8 8.4 8.0 8.6 8.2

Does the data support a mean greater than 8?

3. **Build time.** A compiler claims their CI produces builds in under 30 seconds on average. Eight builds are times (seconds) and displayed below. Is there evidence the true mean is less than 30 seconds?

29.5 30.2 29.8 30.5
29.9 30.1 29.7 30.3

4. **Two message brokers.** A backend team benchmarks publishes latency (ms) for two message brokers, Kafka and RabbitMQ, on separate, unrelated workloads, shown below. Do the mean latencies differ?

Kafka: 12, 14, 11, 13, 12, 15, 13

RabbitMQ: 14, 16, 15, 13, 17, 14, 16

5. **Compile time below a threshold.** A build-optimization team claims that, after their changes, the mean compile time for a project is now less than 90 seconds. Compile times (seconds) from 10 randomly selected builds are:

88 91 87 89 90
86 88 92 87 89

Is there evidence to support the team's claim?

6. **Resting heart rate.** A clinic states that the mean resting heart rate of healthy adults in its patient population is 72 beats per minute. A nurse measures the resting heart rate (bpm) of 12 randomly-selected patients. The results are recorded as follows:

74 70 76 73 71 75
72 78 69 74 73 77

7. **Yield of two crop varieties.** An agronomist compares the yield (bushels per acre) of two wheat varieties grown on separate, randomly-assigned plots, as shown below.

Red Spring: 52, 55, 49, 53, 51, 54, 50, 56

Durum: 47, 45, 50, 48, 46, 49, 44, 47

Determine whether the mean yields of the two varieties differ.

8. **Dissolved oxygen upstream and downstream.** An ecologist measures dissolved oxygen (mg/L) at 9 river sites, taking one reading just upstream and one just downstream of a factory outfall at each site. The data recorded for each site were:

Site:	1	2	3	4	5	6	7	8	9
Upstream:	8.2	7.9	8.5	8.1	7.8	8.3	8.0	8.4	7.7
Downstream:	7.6	7.4	7.9	7.5	7.2	7.8	7.4	7.9	7.1

Test whether the mean dissolved oxygen differs between the upstream and downstream readings.

9. **Spotting outlier payloads.** The following are payload sizes (kB) returned by an API over 15 calls:

498 502 495 610 501
 499 503 497 500 504
 496 502 498 501 500

- (a) Produce a histogram and boxplot of this data in R. What do the plots suggest about the shape and about any unusual observation? Which value stands out and how might it affect a t -test?
 (b) Test whether the mean payload size differs from 500 kB.
10. **Test scores before and after a program.** Ten students take a reading-comprehension test before and after a six-week literacy program. The same students are tested both times.

Patient:	1	2	3	4	5	6	7	8	9	10
Before:	62	70	58	65	72	60	68	55	63	66
After:	68	74	63	70	75	66	71	61	67	72

Test whether the program improves mean reading-comprehension scores.

11. **Cereal mean fill weight.** A cereal box is labelled with a net weight of 500 g. A consumer group suspects the boxes are underfilled on average and weighs 12 boxes (in grams). The results are displayed below.

498 501 497 499
 496 500 495 498
 497 499 496 498

Is there evidence that the mean net weight is less than 500 g?

12. **Weight loss on two diets.** A dietitian compares 12-week weight loss (kg) for two diet programs, using two separate groups of participants. Assume equal variances. The data gathered are as shown below.

Diet A: 6.2, 5.8, 6.5, 6.0, 6.3, 5.9, 6.4, 6.1

Diet B: 4.5, 4.8, 4.2, 4.6, 4.4, 4.7, 4.3, 4.9

Determine whether the mean weight loss on Diet A exceeds that on Diet B by more than 1 kg.

13. **Sprint times under two warm-ups.** A coach compares 100-m sprint times (seconds) for two warm-up routines, using different athletes for each routine.

Dynamic Stretch: 12.1, 12.4, 11.9, 12.2, 12.0, 12.3, 12.1

Static Stretch: 11.7, 11.9, 11.6, 11.8, 12.0, 11.5, 11.8

Determine whether the mean sprint times under the two routines differ.

14. **Magnesium tablet content.** A quality-control chemist checks whether tablets of magnesium contain the labelled 250 mg of active ingredient. The measured content (mg) of 15 randomly-selected tablets is:

248 251 249 252 247
 250 253 249 248 251
 250 246 252 249 250