# Week 1 Homework

ⓘ This is a preview of the published version of the quiz

Started: Jul 2 at 7:46am

# Quiz Instructions

Please answer all the questions below.

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## Question 1

1 pts

(Lesson 1.3: Deterministic Model.) Suppose you throw a rock off a cliff having height $h_0$ = 1000 feet. You're a strong bloke, so the initial downward velocity is $v_0$ = -100 feet/sec (slightly under 70 miles/hr). Further, in this neck of the woods, it turns out there is no friction in the atmosphere - amazing! Now you remember from your Baby Physics class that the height after time $t$ is

$$h(t) = h_0 + v_0 t - 16t^2$$

When does the rock hit the ground?

- a. -11.625 sec
- b. 2 sec
- c. 5.375 sec
- d. 11.625 sec
- e. 10 sec

## Question 2

1 pts

(Lesson 1.3: Stochastic Model.) Consider a single-server queueing system where the times between customer arrivals are independent, identically distributed Exp(λ = 2/hr) random variables; and the service times are i.i.d. Exp(μ = 3/hr). Unfortunately, if a potential arriving customer sees that the server is occupied, he gets mad and leaves the system. Thus, the system can have either 0 or 1 customer in it at any time. This is what's known as an M/M/1/1 queue. If $P(t)$ denotes the probability that a customer is being served at time t, trust me that it can be shown that

$$P(t) \;=\; \tfrac{\lambda}{\lambda+\mu} + \left[P(0) - \tfrac{\lambda}{\lambda+\mu}\right] e^{-(\lambda+\mu)t}.$$

If the system is empty at time 0, i.e., $P(0) = 0$, what is the probability that there will be no people in the system at time 1 hr?

- a. 1
- b. 2/3
- c. 0.397
- d. 0.603

## Question 3

1 pts

(Lesson 1.4: History.) Harry Markowitz (one of the big wheels in simulation language development) won his Nobel Prize for portfolio theory in 1990, though the work that earned him the award was conducted much earlier in the 1950s. Who won the 1990 Prize with him? You are allowed to look this one up.

- a. Merton Miller and William Sharpe
- b. Henry Kissinger
- c. Albert Einstein
- d. Subrahmanyan Chandrasekhar

## Question 4

1 pts

(Lesson 1.5: Applications.) Which of the following situations might be good candidates to use simulation? (There may be more than one correct answer.)

- [ ] a. We put $5000 into a savings account paying 2% continuously compounded interest per year, and we are interested in determining the account's value in 5 years.

- [ ] b. We are interested in investing one half of our portfolio in fixed-interest U.S. bonds and the remaining half in a stock market equity index. We have some information concerning the distribution of stock market returns, but we do not really know what will happen in the market with certainty.

- [ ] c. We have a new strategy for baseball batting orders, and we would like to know if this strategy beats other commonly used batting orders (e.g., a fast guy bats first, a big, strong guy bats fourth, etc.). We have information on the performance of the various team members, but there's a lot of randomness in baseball.

- [ ] d. We have an assembly station in which "customers" (for instance, parts to be manufactured) arrive every 5 minutes exactly and are processed in precisely 4 minutes by a single server. We would like to know how many parts the server can produce in a hour.

- [ ] e. Consider an assembly station in which parts arrive randomly, with independent exponential interarrival times. There is a single server who can process the parts in a random amount of time that is normally distributed. Moreover, the server takes random breaks every once in a while. We would like to know how big any line is likely to get.

- [ ] f. Suppose we are interested in determining the number of doctors needed on Friday night at a local emergency room. We need to insure that 90% of patients get treatment within one hour.

## Question 5

**1 pts**

(Lessons 1.6 and 1.7: Baby Examples.) The planet Glubnor has 50-day years.

Suppose there are 2 Glubnorians in the room. What's the probability that they'll have the same birthday?

- ○ a. $1/(49 \cdot 50)$
- ○ b. 1/50
- ○ c. 1/25
- ○ d. 2/49

## Question 6

1 pts

(Lessons 1.6 and 1.7: Baby Examples.) The planet Glubnor has 50-day years.

Now suppose there are 3 Glubnorians in the room. (They're big, so the room is getting crowded.) What's the probability that at least two of them have the same birthday?

- a. 1/50
- b. 2/50
- c. 1/(49 · 50)
- d. 0.0592

## Question 7

1 pts

(Lessons 1.6 and 1.7: Baby Examples.) Inscribe a circle in a unit square and toss $n = 500$ random darts at the square.

Suppose that 380 of those darts land in the circle. Using the technology developed in this lesson, what is the resulting estimate for $\pi$?

- a. −3.14
- b. 2.82
- c. 3.04
- d. 3.14
- e. 3.82

## Question 8

1 pts

(Lessons 1.6 and 1.7: Baby Examples.) Again inscribe a circle in a unit square and toss $n$ random darts at the square.

What would our estimate be if we let $n \to \infty$ and we applied the same ratio strategy to estimate $\pi$?

- a. $\pi$
- b. $\pi/2$
- c. 3.04
- d. 3.14
- e. $2\pi$

## Question 9

1 pts

(Lessons 1.6 and 1.7: Baby Examples.) Suppose customers arrive at a single-server ice cream parlor times 3, 6, 15, and 17. Further suppose that it takes the server 7, 9, 6, and 8 minutes, respectively, to serve the four customers. When does customer 4 leave the shoppe?

- a. 18
- b. 25
- c. 33
- d. 45

## Question 10

1 pts

(Lesson 1.8: Generating Randomness.) Suppose we are using the (awful) pseudo-random number generator

$$X_i = (5X_{i-1} + 1)\text{mod}(8),$$

with starting value ("seed") $X_0 = 1$. Find the second PRN, $U_2 = X_2/m = X_2/8$.

- a. 0

- b. 1/8
- c. 7/8
- d. 3

## Question 11

1 pts

(Lesson 1.8: Generating Randomness.) Suppose we are using the "decent" pseudo-random number generator

$$X_i = 16807 X_{i-1} \, \text{mod}(2^{31} - 1),$$

with seed $X_0$ = 12345678. Find the resulting integer $X_1$. Feel free to use something like Excel if you need to.

- a. 352515241
- b. 16808
- c. 1335380034
- d. 12345679

## Question 12

1 pts

(Lesson 1.8: Generating Randomness.) Suppose that we generate a pseudo-random number $U$ = 0.128. Use this to generate an Exponential $(\lambda = 1/3)$ random variate.

- a. -6.17
- b. 6.17
- c. -0.685
- d. 0.685

Not saved

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