

EDS 230: Week 6 Assignment: Diffusion

Juliet Cohen, Scout Leonard, Peter Menzies

2022-05-04

1 Intial

```
# run our diffusion model (iterative difference equation) with initial concentration of 10, for 8 times
# using diffusion parameters 0.5 s/m2, 10 m2
result = diff1(initialC = 10,
               nx = 10,
               dx = 1,
               nt = 8,
               dt = 1,
               D = 0.5,
               area = 10)
# initialC = initial concentration (mg/L)
# nx = number of discrete segments
# dx = length of each segment (m)
# nt = # of discrete time intervals
# dt = seconds in each time interval

# a list is returned with our 3 data frames for concentration (conc), qin and qout
result

## $conc
##           [,1]      [,2]      [,3]      [,4]      [,5]      [,6]      [,7]
## [1,] 10.000000 0.000000 0.000000 0.000000 0.000000 0.000000000 0.000000000
## [2,]  7.500000 2.500000 0.000000 0.000000 0.000000 0.000000000 0.000000000
## [3,]  6.250000 3.125000 0.625000 0.000000 0.000000 0.000000000 0.000000000
## [4,]  5.468750 3.281250 1.093750 0.156250 0.000000 0.000000000 0.000000000
## [5,]  4.921875 3.281250 1.406250 0.3515625 0.0390625 0.000000000 0.000000000
## [6,]  4.511719 3.222656 1.611328 0.5371094 0.1074219 0.009765625 0.000000000
## [7,]  4.189453 3.142090 1.745605 0.6982422 0.1904297 0.031738281 0.002441406
## [8,]  3.927612 3.054810 1.832886 0.8331299 0.2777100 0.064086914 0.009155273
##           [,8] [,9] [,10]
## [1,] 0.0000000000 0 0
## [2,] 0.0000000000 0 0
## [3,] 0.0000000000 0 0
## [4,] 0.0000000000 0 0
## [5,] 0.0000000000 0 0
## [6,] 0.0000000000 0 0
## [7,] 0.0000000000 0 0
## [8,] 0.0006103516 0 0
##
## $qout
##           [,1]      [,2]      [,3]      [,4]      [,5]      [,6]      [,7]
```

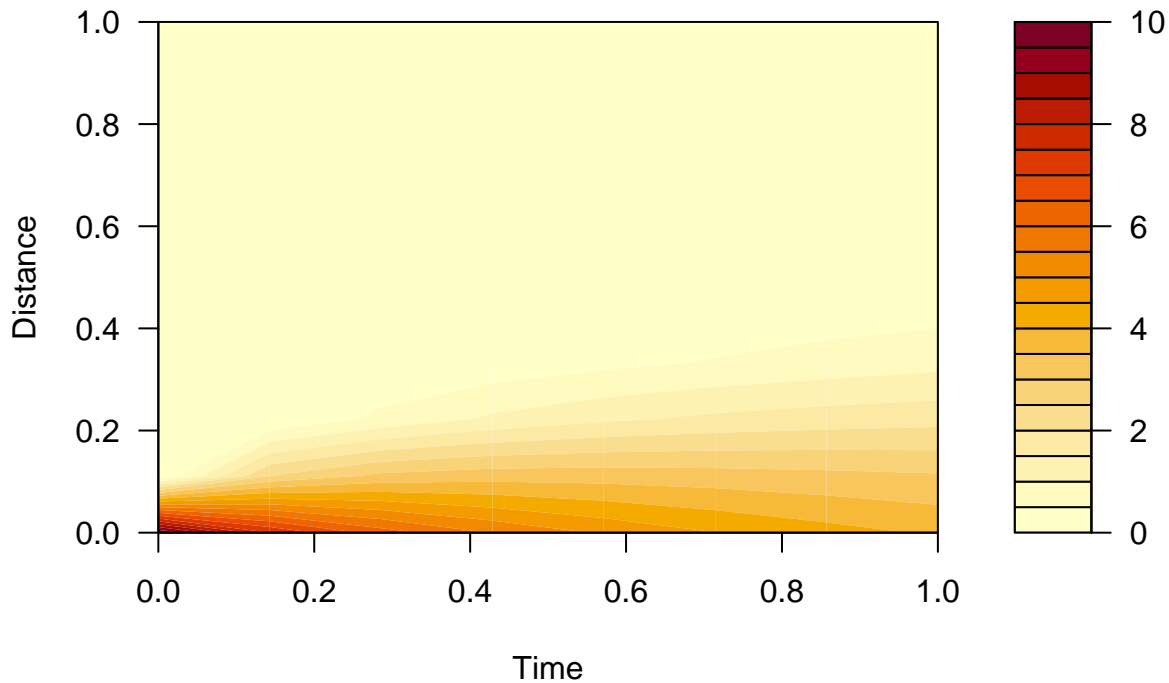
```
## [1,] 25.000000 0.000000 0.000000 0.000000 0.000000000 0.00000000 0.000000000
## [2,] 12.500000 6.250000 0.000000 0.000000 0.000000000 0.00000000 0.000000000
## [3,] 7.812500 6.250000 1.562500 0.000000 0.000000000 0.00000000 0.000000000
## [4,] 5.468750 5.468750 2.343750 0.390625 0.000000000 0.00000000 0.000000000
## [5,] 4.101562 4.687500 2.636719 0.781250 0.09765625 0.00000000 0.000000000
## [6,] 3.222656 4.028320 2.685547 1.074219 0.24414062 0.02441406 0.000000000
## [7,] 2.618408 3.491211 2.618408 1.269531 0.39672852 0.07324219 0.006103516
## [8,] 0.000000 0.000000 0.000000 0.000000 0.000000000 0.00000000 0.000000000
##      [,8] [,9] [,10]
## [1,]    0    0    0
## [2,]    0    0    0
## [3,]    0    0    0
## [4,]    0    0    0
## [5,]    0    0    0
## [6,]    0    0    0
## [7,]    0    0    0
## [8,]    0    0    0
##
## $qin
##      [,1]      [,2]      [,3]      [,4]      [,5]      [,6]      [,7]
## [1,]    0 25.000000 0.000000 0.000000 0.000000 0.000000000 0.000000000
## [2,]    0 12.500000 6.250000 0.000000 0.000000 0.000000000 0.000000000
## [3,]    0 7.812500 6.250000 1.562500 0.000000 0.000000000 0.000000000
## [4,]    0 5.468750 5.468750 2.343750 0.390625 0.000000000 0.000000000
## [5,]    0 4.101562 4.687500 2.636719 0.781250 0.09765625 0.000000000
## [6,]    0 3.222656 4.028320 2.685547 1.074219 0.24414062 0.02441406
## [7,]    0 2.618408 3.491211 2.618408 1.269531 0.39672852 0.07324219
## [8,]    0 0.000000 0.000000 0.000000 0.000000 0.000000000 0.000000000
##      [,8] [,9] [,10]
## [1,] 0.000000000    0    0
## [2,] 0.000000000    0    0
## [3,] 0.000000000    0    0
## [4,] 0.000000000    0    0
## [5,] 0.000000000    0    0
## [6,] 0.000000000    0    0
## [7,] 0.006103516    0    0
## [8,] 0.000000000    0    0
```

used filled contour to plot results

```
head(result$conc)
```

```
##      [,1]      [,2]      [,3]      [,4]      [,5]      [,6] [,7] [,8] [,9]
## [1,] 10.000000 0.000000 0.000000 0.00000000 0.00000000 0.000000000    0    0    0
## [2,] 7.500000 2.500000 0.000000 0.00000000 0.00000000 0.000000000    0    0    0
## [3,] 6.250000 3.125000 0.625000 0.00000000 0.00000000 0.000000000    0    0    0
## [4,] 5.468750 3.281250 1.093750 0.1562500 0.00000000 0.000000000    0    0    0
## [5,] 4.921875 3.281250 1.406250 0.3515625 0.0390625 0.000000000    0    0    0
## [6,] 4.511719 3.222656 1.611328 0.5371094 0.1074219 0.009765625    0    0    0
##      [,10]
## [1,]    0
## [2,]    0
## [3,]    0
## [4,]    0
## [5,]    0
## [6,]    0
```

```
filled.contour(result$conc, xlab="Time", ylab="Distance")
```



```
# or if you prefer this orientation (Distance on x axis)
# filled.contour(t(result$conc), ylab="Time", xlab="Distance")
```

2 Change parameters (increase initial concentration & increase seconds in each time interval)

```
# changes diffusivity and other parameters particularly
# diffusivity, dx and dt

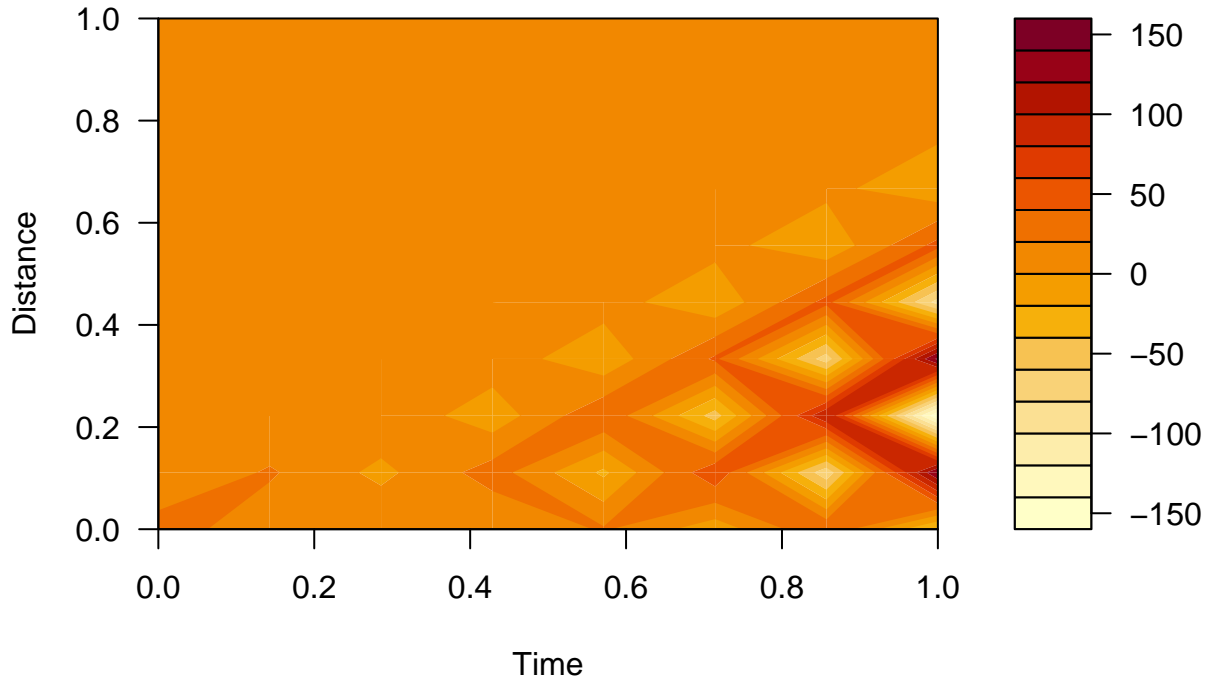
res1 = diff1(initialC = 30, # changed the initial concentration parameter from 10 mg/L to 30 mg/L
             nx = 10,
             dx = 1,
             nt = 8,
             dt = 3, # changed the seconds in each time interval parameter from 1 second to 3 seconds
             D = 0.5,
             area = 10)

# previous:
# result = diff1(initialC = 10,
#               # nx = 10,
#               # dx = 1,
#               # nt = 8,
#               # dt = 1,
#               # D = 0.5,
#               # area = 10)

# initialC = initial concentration (mg/L)
# nx = number of discrete segments
```

```
# dx = length of each segment (m)
# nt = # of discrete time intervals
# dt = seconds in each time interval
```

```
filled.contour(res1$conc, xlab="Time", ylab="Distance")
```



```
# we can also see how much material moved from place to place each time step
#filled.contour(res$qin, xlab="Time", ylab="Distance")
```

```
# changes diffusivity and other parameters particularly
# diffusivity, dx and dt
```

```
res2 = diff1(initialC = 10,
             nx = 2, #decreased the length of each segment from 10 m to 2 m
             dx = 1,
             nt = 6, #decreased the number of time intervals from 8 to 6
             dt = 1,
             D = 0.5,
             area = 10)
```

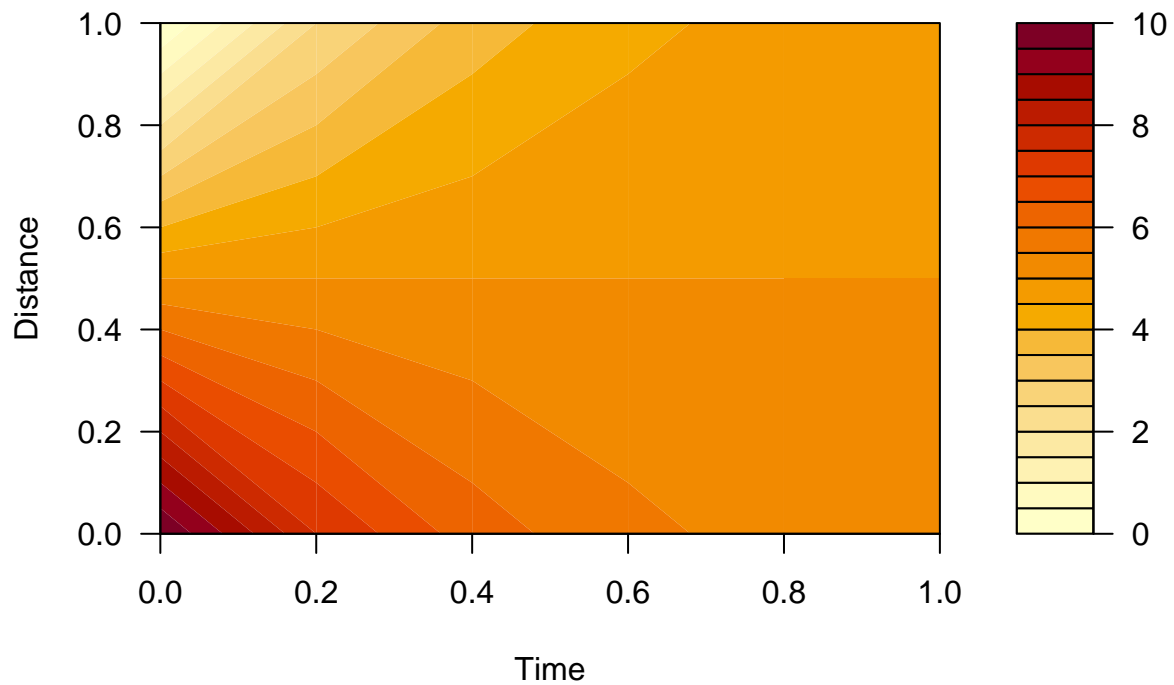
```
# previous:
```

```
# result = diff1(initialC = 10,
                 # nx = 10,
                 # dx = 1,
                 # nt = 8,
                 # dt = 1,
                 # D = 0.5,
                 # area = 10)
```

```
# initialC = initial concentration (mg/L)
# nx = number of discrete segments
# dx = length of each segment (m)
```

```
# nt = # of discrete time intervals  
# dt = seconds in each time interval
```

```
filled.contour(res2$conc, xlab="Time", ylab="Distance")
```



```
# we can also see how much material moved from place to place each time step  
#filled.contour(res$qin, xlab="Time", ylab="Distance")
```