Sensitivity Analysis - Latin Hypercube Sampling

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This environmental model was completed as an assignment for the course, Environmental Data Science 230 | Environmental Science & Management: Modeling Environmental Systems. The goal of this assignment was to build a model … and conduct a … . The model design is based on

1. Code a function to compute atmospheric conductance Cat (how easily vapor diffuses from vegetation surfaces)

```
source(here("atmcon.R"))
```

2. Run `atmcon` model and provide with a single estimate of atmospheric conductance for this forest.

```
ac_forest <- atmcon(vm = 250, h = 1000)
ac_forest
```

```
## $ac
## [1] 15.44228
```

```
ac_forest_rounded <- round(ac_forest[[1]], 2)

print(paste0("The atmospheric conductance for this vegetation is ", ac_forest_rounded, " centimeters pe
```

```
## [1] "The atmospheric conductance for this vegetation is 15.44 centimeters per second."
```

3. Conduct a sensitivity analysis

Consider the sensitivity of estimates to uncertainty in the following parameters and inputs: - h - $k_{d\text{ - }k}0$ - v

```
factors = c("vm", "h", "kd", "k")

nsets = 100

q = c("qnorm", "qunif", "qnorm", "qnorm")

q.arg = list(list(mean = 250, sd = 30),
             list(min = 950, max = 1050),
             list(mean = 0.7, sd = 0.07),
             list(mean = 0.1, sd = 0.01))
q.arg
```

```
## [[1]]
```

```
## [[1]]$mean
## [1] 250
##
## [[1]]$sd
## [1] 30
##
##
## [[2]]
## [[2]]$min
## [1] 950
##
## [[2]]$max
## [1] 1050
##
##
## [[3]]
## [[3]]$mean
## [1] 0.7
##
## [[3]]$sd
## [1] 0.07
##
##
## [[4]]
## [[4]]$mean
## [1] 0.1
##
## [[4]]$sd
## [1] 0.01
```

```
# generate samples
sens_ac = LHS(NULL, factors, nsets, q, q.arg)
#sens_ac
#summary(sens_ac)
#sens_ac$data
# NULL indicates there is no model
sens_pars <- get.data(sens_ac)
sens_pars
```

```
##           vm      h        kd          k
## 1   246.6088  992.5 0.7805245 0.09489927
## 2   223.1058 1048.5 0.8059871 0.10240426
## 3   236.3871  998.5 0.7317634 0.08627796
## 4   204.5769 1043.5 0.6991227 0.08941878
## 5   248.8718 1002.5 0.6682366 0.09431949
## 6   268.8402 1030.5 0.5813222 0.11439531
## 7   243.5590  999.5 0.5628025 0.09861696
## 8   270.7093 1042.5 0.8007672 0.09518273
## 9   250.3760  982.5 0.6720801 0.09573852
## 10  286.0108 1034.5 0.7223048 0.09103527
## 11  208.8339 1023.5 0.6318120 0.10318639
## 12  244.3264 1039.5 0.6956105 0.09601145
## 13  304.3573  959.5 0.7061491 0.10189118
## 14  263.6129  985.5 0.6372469 0.10037608
## 15  212.3930 1038.5 0.6973674 0.10113039
```

```
## 16  281.7436  983.5 0.7043895 0.10722479
## 17  271.6744 1016.5 0.7418432 0.10859617
## 18  251.1282  981.5 0.5480937 0.09176106
## 19  272.6625  984.5 0.7627531 0.10934589
## 20  264.4518 1013.5 0.6082595 0.09140383
## 21  287.6070  975.5 0.6903187 0.10345126
## 22  247.3647 1026.5 0.7552434 0.09628144
## 23  273.6757  954.5 0.6831702 0.09065411
## 24  256.4410 1041.5 0.7279199 0.09962392
## 25  274.7168 1017.5 0.6642949 0.10538836
## 26  233.8349  952.5 0.8186778 0.10597760
## 27  257.2128  979.5 0.7204662 0.10371856
## 28  237.2156 1019.5 0.6345787 0.09402240
## 29  269.7651 1024.5 0.6538814 0.10163658
## 30  195.6427  965.5 0.7528791 0.09810882
## 31  213.9892  962.5 0.7601732 0.09654874
## 32  276.8942 1046.5 0.6471209 0.10896473
## 33  224.2115 1000.5 0.5881265 0.09371994
## 34  293.1859 1015.5 0.7654213 0.10755415
## 35  258.7712  950.5 0.6622815 0.10012533
## 36  191.2011  988.5 0.6560396 0.09681361
## 37  221.9623  974.5 0.7917405 0.10658838
## 38  260.3538  987.5 0.7357051 0.09937293
## 39  291.1661 1001.5 0.7397636 0.10266311
## 40  283.0919 1037.5 0.7877496 0.11811911
## 41  254.9098 1004.5 0.7483216 0.08485898
## 42  248.1188 1029.5 0.6739701 0.07829910
## 43  219.5433  972.5 0.6423274 0.10481727
## 44  206.8141 1018.5 0.5196919 0.09341162
## 45  259.5592 1028.5 0.7576726 0.09546238
## 46  225.2832 1006.5 0.6159749 0.10789192
## 47  308.7989 1014.5 0.8371975 0.09987467
## 48  255.6736 1008.5 0.6701696 0.11598193
## 49  245.8509  993.5 0.8118735 0.09733689
## 50  295.4231  991.5 0.6795338 0.08984778
## 51  226.3243  960.5 0.6920873 0.11058122
## 52  230.2349  956.5 0.7461186 0.09309691
## 53  265.3022  990.5 0.6122504 0.09707625
## 54  242.7872  951.5 0.6938509 0.10510073
## 55  279.2234  996.5 0.6494265 0.09210808
## 56  232.0672 1010.5 0.7150291 0.09886961
## 57  240.4408  970.5 0.8268337 0.07424171
## 58  210.6826 1040.5 0.6776952 0.11200359
## 59  284.5105 1031.5 0.7008773 0.11310579
## 60  215.4895  953.5 0.7337209 0.10398855
## 61  266.1651  995.5 0.6662791 0.08896937
## 62  261.9657  957.5 0.6885439 0.10974114
## 63  231.1598 1027.5 0.7132383 0.12575829
## 64  327.2749  958.5 0.5731663 0.10062707
## 65  267.9328 1044.5 0.6516784 0.08304602
## 66  261.1557  989.5 0.6039457 0.11015222
## 67  262.7844  986.5 0.6259315 0.10453762
## 68  229.2907  971.5 0.7186417 0.11695398
## 69  202.0542  976.5 0.6289345 0.09461164
```

```
## 70  184.8973  978.5 0.8519063 0.11253565
## 71  251.8812 1012.5 0.6849709 0.10628006
## 72  218.2564 1035.5 0.7168298 0.11959964
## 73  238.0343 1025.5 0.6227856 0.11372204
## 74  315.1027  966.5 0.5940129 0.11150349
## 75  278.0377  980.5 0.6867617 0.08689421
## 76  253.3912  968.5 0.5992328 0.08799641
## 77  297.9458 1036.5 0.7377185 0.12170090
## 78  216.9081 1003.5 0.7026326 0.10138304
## 79  239.6462 1009.5 0.7505735 0.10823894
## 80  275.7885  961.5 0.7298304 0.11103063
## 81  249.6240 1032.5 0.6194755 0.08401807
## 82  267.0415 1021.5 0.7260299 0.10690309
## 83  245.0902 1020.5 0.7740685 0.10292375
## 84  232.9585 1047.5 0.6398268 0.08040036
## 85  234.6978 1022.5 0.7079127 0.10214702
## 86  280.4567  967.5 0.7114561 0.09244585
## 87  228.3256  963.5 0.7096813 0.10087845
## 88  257.9893 1033.5 0.7840251 0.09025886
## 89  300.8619  973.5 0.7772144 0.08746435
## 90  172.7251  964.5 0.6813583 0.09277521
## 91  235.5482  969.5 0.7681880 0.09785298
## 92  199.1381 1007.5 0.7241588 0.10426148
## 93  227.3375  955.5 0.6602364 0.11514102
## 94  220.7766  997.5 0.6447566 0.09912155
## 95  241.2288 1045.5 0.7439604 0.08849651
## 96  254.1491 1005.5 0.8803081 0.08188089
## 97  252.6353  994.5 0.6758412 0.09759574
## 98  289.3174  977.5 0.7710655 0.08560469
## 99  242.0107 1011.5 0.7960543 0.10568051
## 100 238.8443 1049.5 0.6581568 0.09836342
```

Summary of results

```r
source(here("atmcon.R"))
ac_lhs <- pmap(sens_pars, atmcon)
head(ac_lhs[[2]])
```

```
## $ac
## [1] 20.37298
```

```r
atmospheric_conductances <- ac_lhs %>%
  map_dfr(`[`, "ac")

atmospheric_conductances
```

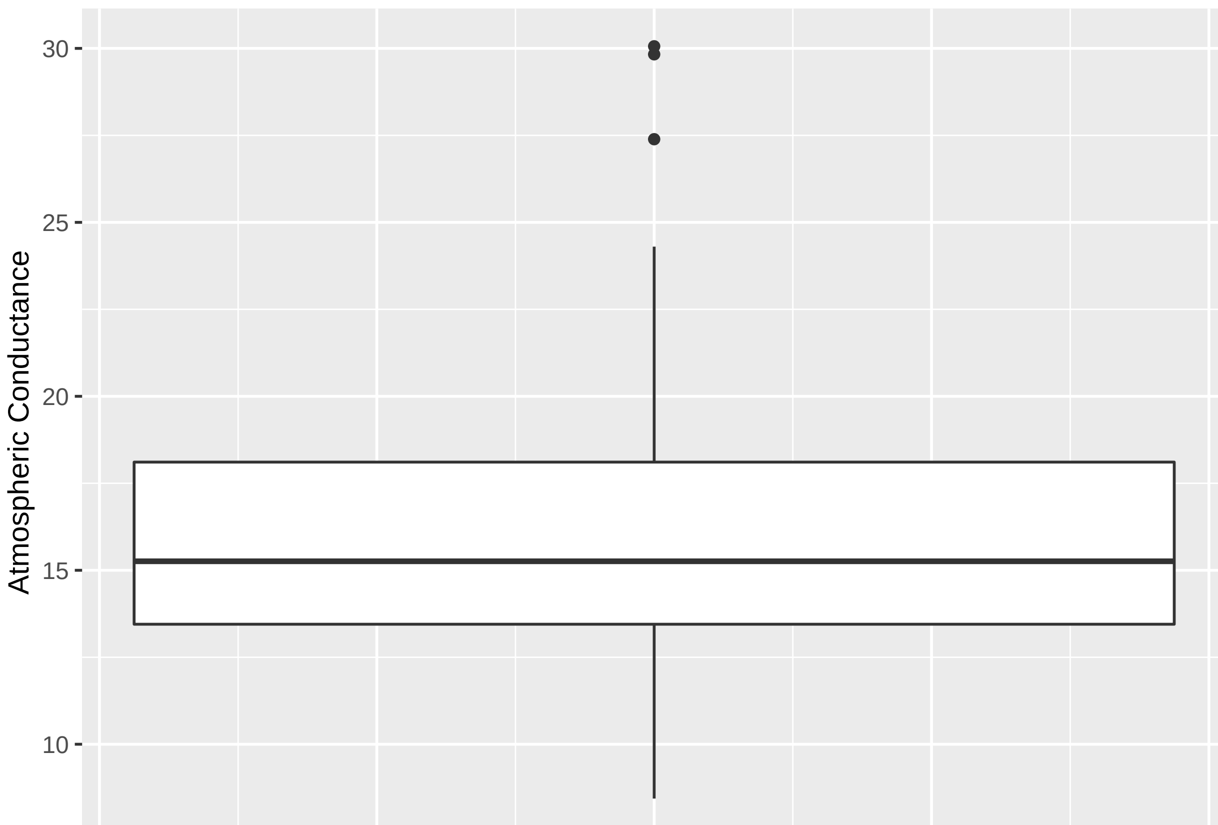
```
## # A tibble: 100 x 1
##       ac
##    <dbl>
##  1  17.8
##  2  20.4
##  3  13.2
##  4  11.2
##  5  13.3
##  6  15.3
```

```
## 	7	11.2
## 	8	21.7
## 	9	13.6
## 10	16.9
## # ... with 90 more rows
```

C. Graph

```
#data <- atmospheric_conductances %>%
#  gather(value = "value", key = )

ggplot(data = atmospheric_conductances, aes(y = ac)) +
  geom_boxplot() +
  labs(y = "Atmospheric Conductance") +
  #theme(x = element_blank()) +
  theme(axis.title.x = element_blank(),
        axis.text.x = element_blank(),
        axis.ticks.x = element_blank())
```



D. Graph

```
#pse::plotscatter(sens_ac)
```

E. Plot PRCC

F. Discussion

References