rabbits

5/18/2021

```
source("evolve_pop2.R") # evolve_pop2 is updated version of function from Rachel


# set up best guess case
# survivability - based on mortality rates per thousand per decade
p12 = 0.8
p23 = 0.85
p34 = 0.65
p45 = 0.1

F1 = 0
F2 = 2
F3 = 6
F4 = 1

# initial population parameters
ini = c(0,0,10,0)
nyears = 20
fert_rabbit = c(F1,F2,F3,F4)
surv_rabbit = c(p12,p23,p34,p45)
rabbit_pop=evolve_pop2(fert_rabbit, surv_rabbit, ini, nyears)

# population after 20 years
pop20 = rabbit_pop$poptot[20]
```

Q1:What is the total rabbit population after 20 years.

ANS: population after 20 years is 6.8021534^{6}

```
year = seq(from=1, to=nyears)
rabbit_ages = cbind.data.frame(year=year, t(rabbit_pop$popbyage))
young20 = rabbit_ages[20,2]
```

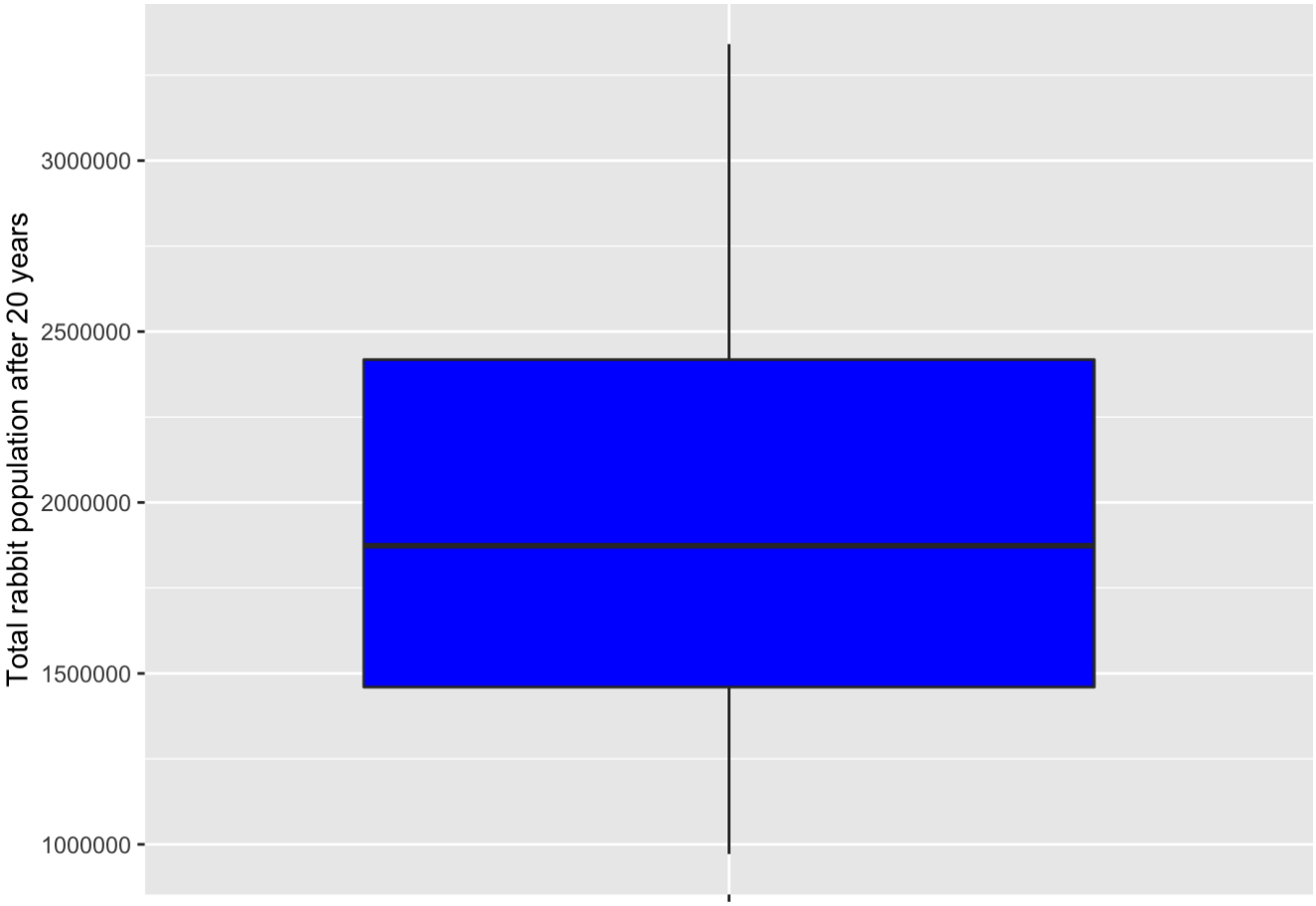
Q2: How many young rabbits (first age class) are there in the population at that time?

ANS: There are 4.1116794^{6} young rabbits (first age class) in the population at that time.

Q3: Plot-Total rabbit population variation after 20 years

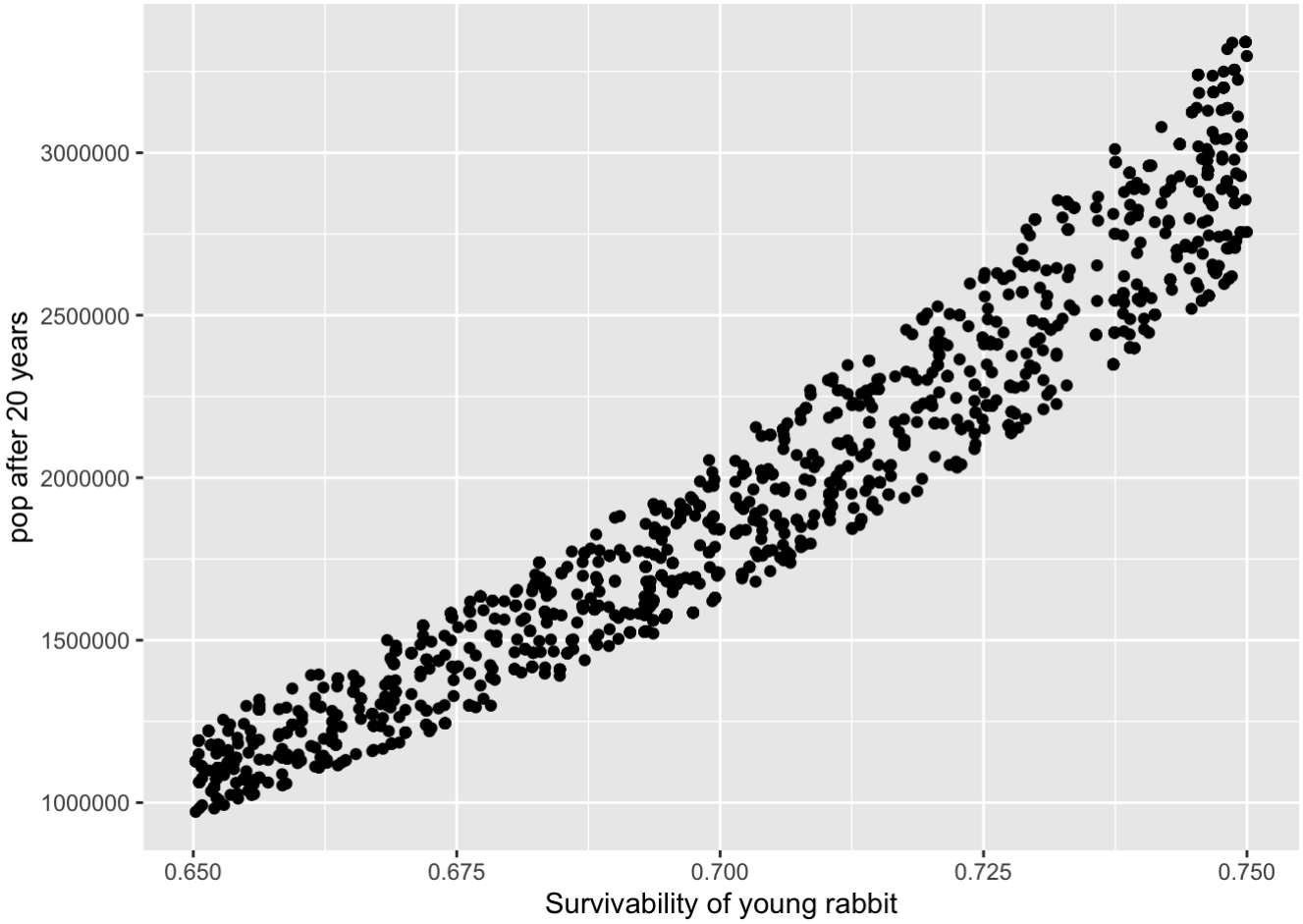
```
library(sensitivity)

# survivability

nsample=200


# create our two samples for Sobel
# first do our survivability
ps1 = cbind.data.frame(p12=runif(min=0.65, max=0.75, n=nsample), p23 = runif(min=0.75, m
ax=0.8, n=nsample),
                       p34 = runif(min=0.65, max=0.65, n=nsample), p45 = runif(min=0.1,
 max=0.1, n=nsample))

fs1 = cbind.data.frame(f1 = runif(min=0, max=0, n=nsample),
                       f2 = runif(min=2, max=2, n=nsample),
                       f3 = runif(min=6, max=6, n=nsample),
                       f4 = runif(min=1, max=1, n=nsample))

ps2 = cbind.data.frame(p12=runif(min=0.65, max=0.75, n=nsample), p23 = runif(min=0.75, m
ax=0.8, n=nsample),
                       p34 = runif(min=0.65, max=0.65, n=nsample), p45 = runif(min=0.1,
 max=0.1, n=nsample))

fs2 = cbind.data.frame(f1 = runif(min=0, max=0, n=nsample),
                       f2 = runif(min=2, max=2, n=nsample),
                       f3 = runif(min=6, max=6, n=nsample),
                       f4 = runif(min=1, max=1, n=nsample))

# put servivability and fertility together
allp1 = cbind.data.frame(ps1,fs1)
allp2 = cbind.data.frame(ps2,fs2)

# get sobel samples
sens_rabbit=soboljansen(model = NULL, allp1, allp2, nboot = 100)

# head(sens_rabbit$X)
nsim=nrow(sens_rabbit$X)

# run model and save what we care about: final population after 20 years

ini = c(0,0,10, 0)
nyears = 20

# as before combine our application of the the dynamics model - for each
# parameter set, with code to extract our metric of interest (final population)
p_wrapper = function(p12, p23, p34, p45, f1,f2,f3,f4, use_func, initialpop, nstep ) {
fertility=c(f1,f2,f3, f4)
survivability= c(p12,p23,p34,p45)
res = use_func(survivability =survivability, fertility = fertility, initialpop=initialpo
p, nstep=nstep)
# now return the final population total
return(finalpop=res$poptot[nstep])
```

```
}

# use pmap here so we can specify rows of our sensitivity analysis parameter object
res = as.data.frame(sens_rabbit$X) %>% pmap_dbl(p_wrapper, initialpop=ini, nstep=nyears,
use_func=evolve_pop2)

# plot results (variation in final population across all parameter)
ggplot(data.frame(finalpop=res), aes(x="", y=finalpop) )+geom_boxplot(fill="blue")+
  theme(axis.title.x = element_blank())+labs(y="Total rabbit population after 20 years")
```



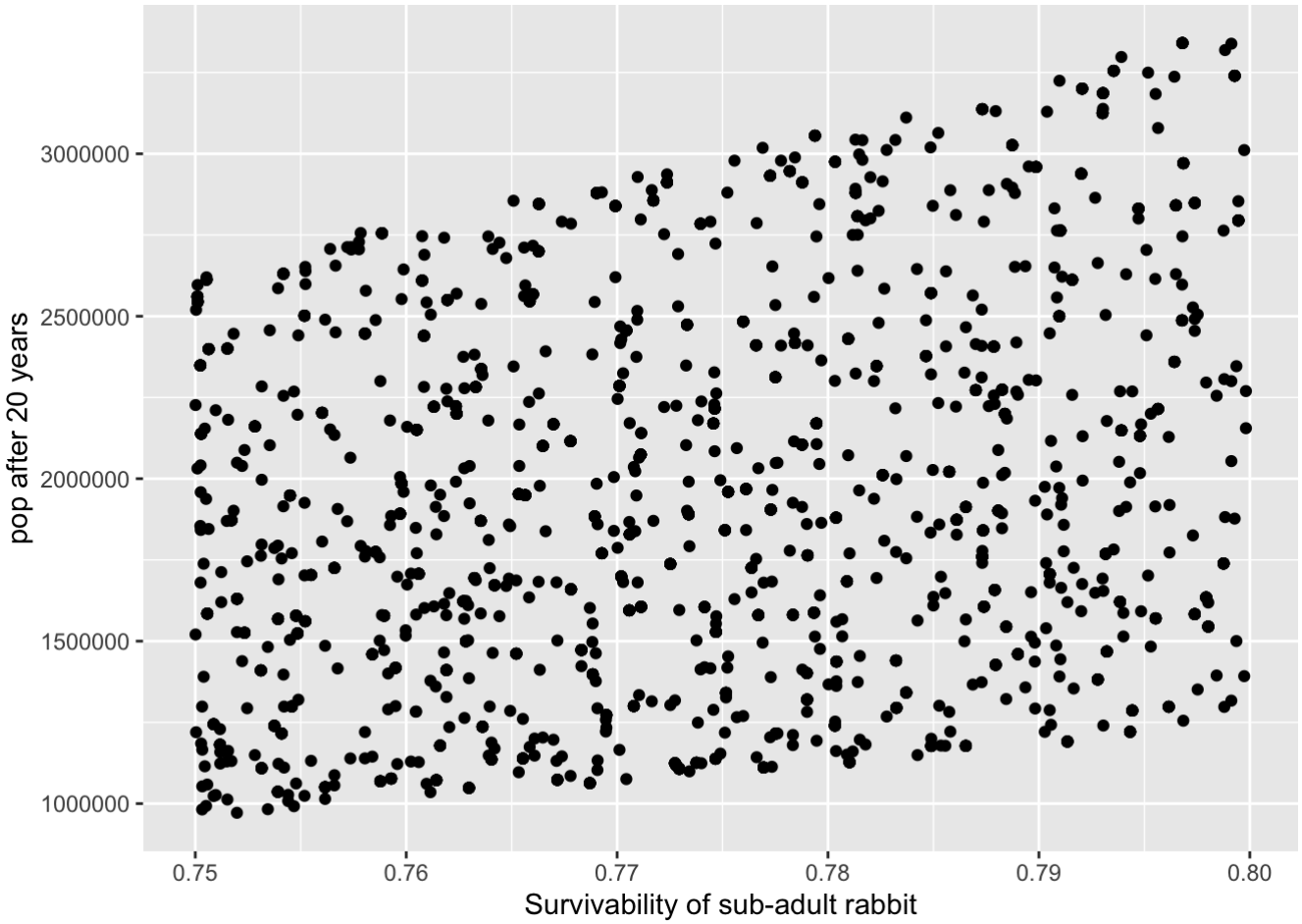
Q4: Plot-total rabbit population after 20 years varies with survivability of Young Age

```
# give our results to sensitivity structure

sens_rabbit=tell(sens_rabbit, res)

# loot at results
#sens_rabbit$S
#sens_rabbit$T

# graph the most sensitive parameter
tmp = cbind.data.frame(sens_rabbit$X, pop20=sens_rabbit$y)
ggplot(tmp, aes(p12, pop20))+geom_point()+labs(x="Survivability of young rabbit",y="pop
 after 20 years")
```



Q5: Plot-total rabbit population after 20 years varies with survivability of sub-adult

```
tmp2 = cbind.data.frame(sens_rabbit$X, pop20=sens_rabbit$y)
ggplot(tmp, aes(p23, pop20))+geom_point()+labs(x="Survivability of sub-adult rabbit",y=
"pop after 20 years")
```



D6: How does this compare with total rabbit population after 20 years in your original population model

ANS: The rabbit population decreases dramatically comparing to the original model, almost 1/4 of the original final population.

End Assignment 7