

Session 2: Workspace Management and Functions in R

QM 1

2022-10-18

WORKSPACE MANAGEMENT (ls, rm, save, load, ...)

```
# list all variables in workspace:
```

```
ls()
```

```
## character(0)
```

```
# define objects x, y, a
```

```
x <- c(1, 2)
```

```
y <- c(2, 3)
```

```
a <- pi
```

```
ls()
```

```
## [1] "a" "x" "y"
```

```
# get working directory
```

```
getwd()
```

```
## [1] "C:/Users/jmatyaso/WU/QM I/Rsessions"
```

```
# list files in current working directory
```

```
dir()
```

```
## [1] "R_script_week1.R"      "R_script_week2.R"
```

```
## [3] "R_script_week2.spin.R"  "R_script_week2.spin.Rmd"
```

```
# change to parent directory
```

```
setwd("../")
```

```
getwd()
```

```
## [1] "C:/Users/jmatyaso/WU/QM I"
```

```
dir()
```

```
## [1] "Rsessions"
```

```
# change to child folder "RSessions"
```

```
setwd("RSessions")
```

```
getwd()
```

```
## [1] "C:/Users/jmatyaso/WU/QM I/RSessions"
```

```
dir()
```

```
## [1] "R_script_week1.R"      "R_script_week2.R"
```

```
## [3] "R_script_week2.spin.R"  "R_script_week2.spin.Rmd"
```

```
# save y in a file called "secret.RData" within the current working directory
```

```
save(y, file = "secret.RData")
```

```
dir()
```

```

## [1] "R_script_week1.R"      "R_script_week2.R"
## [3] "R_script_week2.spin.R"    "R_script_week2.spin.Rmd"
## [5] "secret.RData"

# save an image of the workspace in a file called "First_WorkSpace.RData"
# within the current working directory
save.image("First_WorkSpace.RData")
dir()

## [1] "First_WorkSpace.RData"    "R_script_week1.R"
## [3] "R_script_week2.R"         "R_script_week2.spin.R"
## [5] "R_script_week2.spin.Rmd"  "secret.RData"

# remove variables from workspace:
rm(x,y,a)
ls()

## character(0)

# load data from file "secret.RData" the current working directory
load("secret.RData")
ls()

## [1] "y"

# load data from file "First_WorkSpace.RData" the current working directory
load("First_WorkSpace.RData")
ls()

## [1] "a" "x" "y"

DEFINE AND PLOT FUNCTIONS

# Define a function C with variable x, compare example on slide 9
C <- function(x) {
  100 * x * sqrt(x) + 500
}

# print objective value at x=1
C(1)

## [1] 600

# print all objective values for x = 0,...,10
C(0:10)

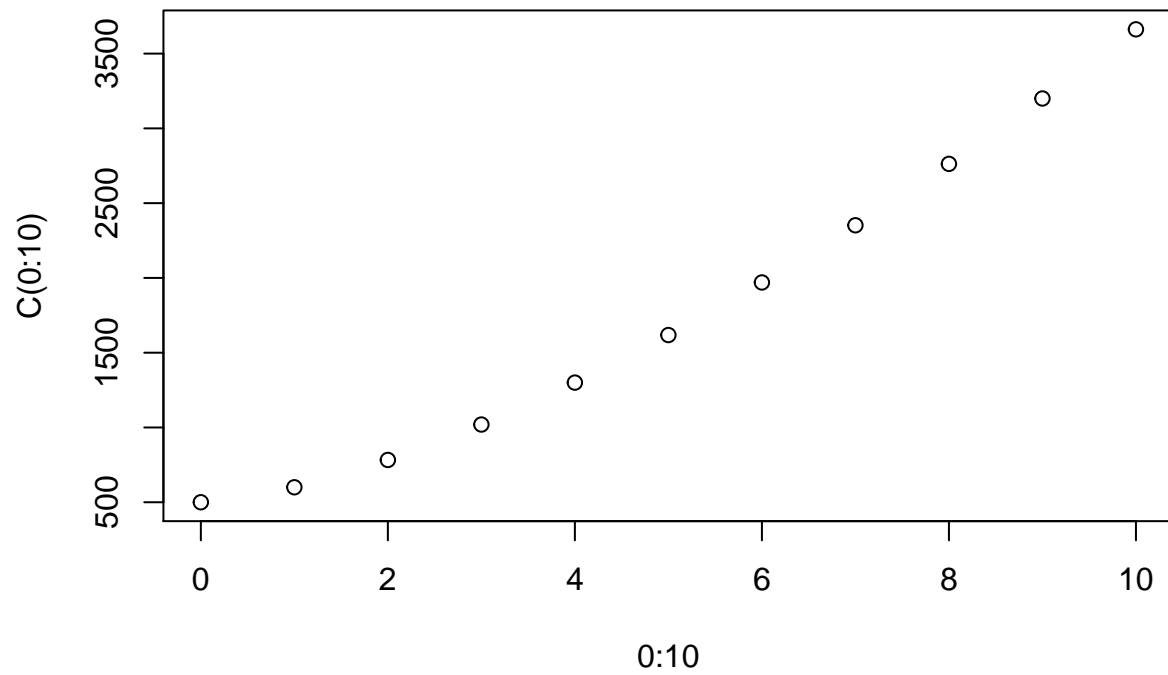
## [1] 500.0000 600.0000 782.8427 1019.6152 1300.0000 1618.0340 1969.6938
## [8] 2352.0259 2762.7417 3200.0000 3662.2777

# have a look at C itself
C

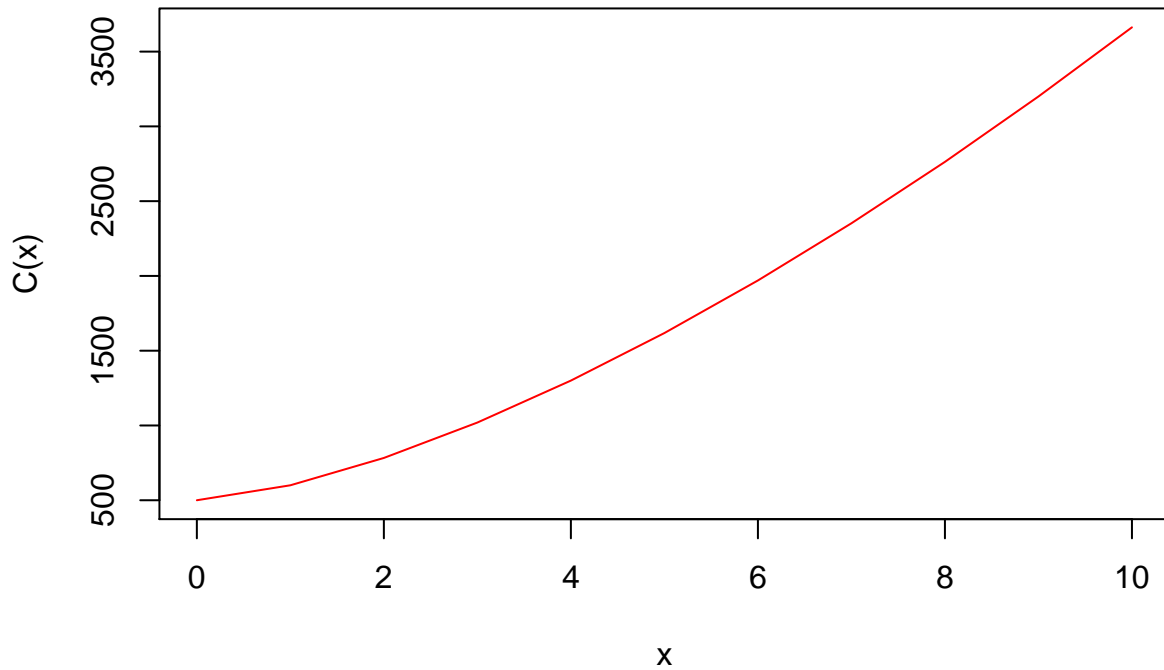
## function(x) {
##   100 * x * sqrt(x) + 500
## }
## <bytecode: 0x0000000015b96d60>

# generate a plot with coordinates x = 0,...,10 and y = C(0),...,C(10)
plot(0:10,C(0:10))

```



```
# generate a plot, with specified options 'type' and 'color'  
x <- 0:10  
plot(x, C(x), type = 'l', col = 'red')
```



```
colors()
```

```
## [1] "white"           "aliceblue"       "antiquewhite"
## [4] "antiquewhite1"  "antiquewhite2"  "antiquewhite3"
## [7] "antiquewhite4"  "aquamarine"     "aquamarine1"
## [10] "aquamarine2"    "aquamarine3"    "aquamarine4"
## [13] "azure"          "azure1"         "azure2"
## [16] "azure3"         "azure4"         "beige"
## [19] "bisque"         "bisque1"        "bisque2"
## [22] "bisque3"        "bisque4"        "black"
## [25] "blanchedalmond" "blue"           "blue1"
## [28] "blue2"          "blue3"          "blue4"
## [31] "blueviolet"     "brown"          "brown1"
## [34] "brown2"         "brown3"         "brown4"
## [37] "burlywood"      "burlywood1"     "burlywood2"
## [40] "burlywood3"     "burlywood4"     "cadetblue"
## [43] "cadetblue1"     "cadetblue2"     "cadetblue3"
## [46] "cadetblue4"     "chartreuse"     "chartreuse1"
## [49] "chartreuse2"    "chartreuse3"    "chartreuse4"
## [52] "chocolate"      "chocolate1"    "chocolate2"
## [55] "chocolate3"    "chocolate4"    "coral"
## [58] "coral1"         "coral2"         "coral3"
## [61] "coral4"         "cornflowerblue" "cornsilk"
## [64] "cornsilk1"      "cornsilk2"      "cornsilk3"
## [67] "cornsilk4"      "cyan"           "cyan1"
## [70] "cyan2"          "cyan3"          "cyan4"
```

## [73]	"darkblue"	"darkcyan"	"darkgoldenrod"
## [76]	"darkgoldenrod1"	"darkgoldenrod2"	"darkgoldenrod3"
## [79]	"darkgoldenrod4"	"darkgray"	"darkgreen"
## [82]	"darkgrey"	"darkkhaki"	"darkmagenta"
## [85]	"darkolivegreen"	"darkolivegreen1"	"darkolivegreen2"
## [88]	"darkolivegreen3"	"darkolivegreen4"	"darkorange"
## [91]	"darkorange1"	"darkorange2"	"darkorange3"
## [94]	"darkorange4"	"darkorchid"	"darkorchid1"
## [97]	"darkorchid2"	"darkorchid3"	"darkorchid4"
## [100]	"darkred"	"darksalmon"	"darkseagreen"
## [103]	"darkseagreen1"	"darkseagreen2"	"darkseagreen3"
## [106]	"darkseagreen4"	"darkslateblue"	"darkslategray"
## [109]	"darkslategray1"	"darkslategray2"	"darkslategray3"
## [112]	"darkslategray4"	"darkslategray"	"darkturquoise"
## [115]	"darkviolet"	"deeppink"	"deeppink1"
## [118]	"deeppink2"	"deeppink3"	"deeppink4"
## [121]	"deepskyblue"	"deepskyblue1"	"deepskyblue2"
## [124]	"deepskyblue3"	"deepskyblue4"	"dimgray"
## [127]	"dimgrey"	"dodgerblue"	"dodgerblue1"
## [130]	"dodgerblue2"	"dodgerblue3"	"dodgerblue4"
## [133]	"firebrick"	"firebrick1"	"firebrick2"
## [136]	"firebrick3"	"firebrick4"	"floralwhite"
## [139]	"forestgreen"	"gainsboro"	"ghostwhite"
## [142]	"gold"	"gold1"	"gold2"
## [145]	"gold3"	"gold4"	"goldenrod"
## [148]	"goldenrod1"	"goldenrod2"	"goldenrod3"
## [151]	"goldenrod4"	"gray"	"gray0"
## [154]	"gray1"	"gray2"	"gray3"
## [157]	"gray4"	"gray5"	"gray6"
## [160]	"gray7"	"gray8"	"gray9"
## [163]	"gray10"	"gray11"	"gray12"
## [166]	"gray13"	"gray14"	"gray15"
## [169]	"gray16"	"gray17"	"gray18"
## [172]	"gray19"	"gray20"	"gray21"
## [175]	"gray22"	"gray23"	"gray24"
## [178]	"gray25"	"gray26"	"gray27"
## [181]	"gray28"	"gray29"	"gray30"
## [184]	"gray31"	"gray32"	"gray33"
## [187]	"gray34"	"gray35"	"gray36"
## [190]	"gray37"	"gray38"	"gray39"
## [193]	"gray40"	"gray41"	"gray42"
## [196]	"gray43"	"gray44"	"gray45"
## [199]	"gray46"	"gray47"	"gray48"
## [202]	"gray49"	"gray50"	"gray51"
## [205]	"gray52"	"gray53"	"gray54"
## [208]	"gray55"	"gray56"	"gray57"
## [211]	"gray58"	"gray59"	"gray60"
## [214]	"gray61"	"gray62"	"gray63"
## [217]	"gray64"	"gray65"	"gray66"
## [220]	"gray67"	"gray68"	"gray69"
## [223]	"gray70"	"gray71"	"gray72"
## [226]	"gray73"	"gray74"	"gray75"
## [229]	"gray76"	"gray77"	"gray78"
## [232]	"gray79"	"gray80"	"gray81"

## [235]	"gray82"	"gray83"	"gray84"
## [238]	"gray85"	"gray86"	"gray87"
## [241]	"gray88"	"gray89"	"gray90"
## [244]	"gray91"	"gray92"	"gray93"
## [247]	"gray94"	"gray95"	"gray96"
## [250]	"gray97"	"gray98"	"gray99"
## [253]	"gray100"	"green"	"green1"
## [256]	"green2"	"green3"	"green4"
## [259]	"greenyellow"	"grey"	"grey0"
## [262]	"grey1"	"grey2"	"grey3"
## [265]	"grey4"	"grey5"	"grey6"
## [268]	"grey7"	"grey8"	"grey9"
## [271]	"grey10"	"grey11"	"grey12"
## [274]	"grey13"	"grey14"	"grey15"
## [277]	"grey16"	"grey17"	"grey18"
## [280]	"grey19"	"grey20"	"grey21"
## [283]	"grey22"	"grey23"	"grey24"
## [286]	"grey25"	"grey26"	"grey27"
## [289]	"grey28"	"grey29"	"grey30"
## [292]	"grey31"	"grey32"	"grey33"
## [295]	"grey34"	"grey35"	"grey36"
## [298]	"grey37"	"grey38"	"grey39"
## [301]	"grey40"	"grey41"	"grey42"
## [304]	"grey43"	"grey44"	"grey45"
## [307]	"grey46"	"grey47"	"grey48"
## [310]	"grey49"	"grey50"	"grey51"
## [313]	"grey52"	"grey53"	"grey54"
## [316]	"grey55"	"grey56"	"grey57"
## [319]	"grey58"	"grey59"	"grey60"
## [322]	"grey61"	"grey62"	"grey63"
## [325]	"grey64"	"grey65"	"grey66"
## [328]	"grey67"	"grey68"	"grey69"
## [331]	"grey70"	"grey71"	"grey72"
## [334]	"grey73"	"grey74"	"grey75"
## [337]	"grey76"	"grey77"	"grey78"
## [340]	"grey79"	"grey80"	"grey81"
## [343]	"grey82"	"grey83"	"grey84"
## [346]	"grey85"	"grey86"	"grey87"
## [349]	"grey88"	"grey89"	"grey90"
## [352]	"grey91"	"grey92"	"grey93"
## [355]	"grey94"	"grey95"	"grey96"
## [358]	"grey97"	"grey98"	"grey99"
## [361]	"grey100"	"honeydew"	"honeydew1"
## [364]	"honeydew2"	"honeydew3"	"honeydew4"
## [367]	"hotpink"	"hotpink1"	"hotpink2"
## [370]	"hotpink3"	"hotpink4"	"indianred"
## [373]	"indianred1"	"indianred2"	"indianred3"
## [376]	"indianred4"	"ivory"	"ivory1"
## [379]	"ivory2"	"ivory3"	"ivory4"
## [382]	"khaki"	"khaki1"	"khaki2"
## [385]	"khaki3"	"khaki4"	"lavender"
## [388]	"lavenderblush"	"lavenderblush1"	"lavenderblush2"
## [391]	"lavenderblush3"	"lavenderblush4"	"lawngreen"
## [394]	"lemonchiffon"	"lemonchiffon1"	"lemonchiffon2"

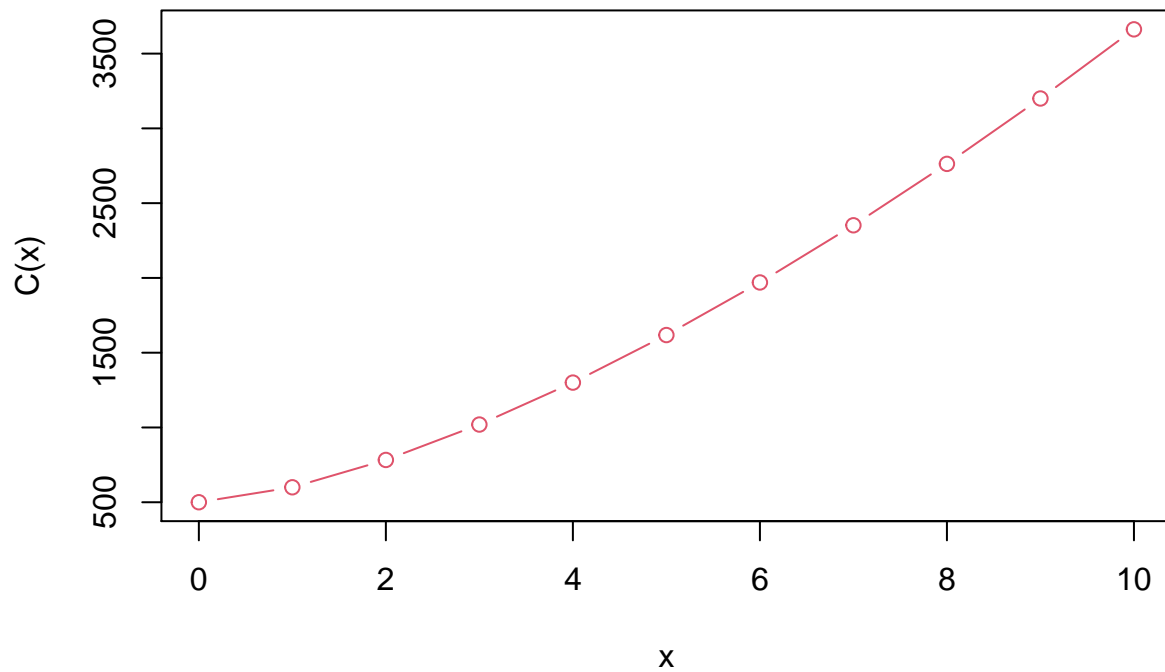
## [397]	"lemonchiffon3"	"lemonchiffon4"	"lightblue"
## [400]	"lightblue1"	"lightblue2"	"lightblue3"
## [403]	"lightblue4"	"lightcoral"	"lightcyan"
## [406]	"lightcyan1"	"lightcyan2"	"lightcyan3"
## [409]	"lightcyan4"	"lightgoldenrod"	"lightgoldenrod1"
## [412]	"lightgoldenrod2"	"lightgoldenrod3"	"lightgoldenrod4"
## [415]	"lightgoldenrodyellow"	"lightgray"	"lightgreen"
## [418]	"lightgrey"	"lightpink"	"lightpink1"
## [421]	"lightpink2"	"lightpink3"	"lightpink4"
## [424]	"lightsalmon"	"lightsalmon1"	"lightsalmon2"
## [427]	"lightsalmon3"	"lightsalmon4"	"lightseagreen"
## [430]	"lightskyblue"	"lightskyblue1"	"lightskyblue2"
## [433]	"lightskyblue3"	"lightskyblue4"	"lightslateblue"
## [436]	"lightslategray"	"lightslategrey"	"lightsteelblue"
## [439]	"lightsteelblue1"	"lightsteelblue2"	"lightsteelblue3"
## [442]	"lightsteelblue4"	"lightyellow"	"lightyellow1"
## [445]	"lightyellow2"	"lightyellow3"	"lightyellow4"
## [448]	"limegreen"	"linen"	"magenta"
## [451]	"magenta1"	"magenta2"	"magenta3"
## [454]	"magenta4"	"maroon"	"maroon1"
## [457]	"maroon2"	"maroon3"	"maroon4"
## [460]	"mediumaquamarine"	"mediumblue"	"mediumorchid"
## [463]	"mediumorchid1"	"mediumorchid2"	"mediumorchid3"
## [466]	"mediumorchid4"	"mediumpurple"	"mediumpurple1"
## [469]	"mediumpurple2"	"mediumpurple3"	"mediumpurple4"
## [472]	"mediumseagreen"	"mediumslateblue"	"mediumspringgreen"
## [475]	"mediumturquoise"	"mediumvioletred"	"midnightblue"
## [478]	"mintcream"	"mistyrose"	"mistyrose1"
## [481]	"mistyrose2"	"mistyrose3"	"mistyrose4"
## [484]	"moccasin"	"navajowhite"	"navajowhite1"
## [487]	"navajowhite2"	"navajowhite3"	"navajowhite4"
## [490]	"navy"	"navyblue"	"oldlace"
## [493]	"olivedrab"	"olivedrab1"	"olivedrab2"
## [496]	"olivedrab3"	"olivedrab4"	"orange"
## [499]	"orange1"	"orange2"	"orange3"
## [502]	"orange4"	"orangered"	"orangered1"
## [505]	"orangered2"	"orangered3"	"orangered4"
## [508]	"orchid"	"orchid1"	"orchid2"
## [511]	"orchid3"	"orchid4"	"palegoldenrod"
## [514]	"palegreen"	"palegreen1"	"palegreen2"
## [517]	"palegreen3"	"palegreen4"	"paleturquoise"
## [520]	"paleturquoise1"	"paleturquoise2"	"paleturquoise3"
## [523]	"paleturquoise4"	"palevioletred"	"palevioletred1"
## [526]	"palevioletred2"	"palevioletred3"	"palevioletred4"
## [529]	"papayawhip"	"peachpuff"	"peachpuff1"
## [532]	"peachpuff2"	"peachpuff3"	"peachpuff4"
## [535]	"peru"	"pink"	"pink1"
## [538]	"pink2"	"pink3"	"pink4"
## [541]	"plum"	"plum1"	"plum2"
## [544]	"plum3"	"plum4"	"powderblue"
## [547]	"purple"	"purple1"	"purple2"
## [550]	"purple3"	"purple4"	"red"
## [553]	"red1"	"red2"	"red3"
## [556]	"red4"	"rosybrown"	"rosybrown1"

```

## [559] "rosybrown2"      "rosybrown3"      "rosybrown4"
## [562] "royalblue"        "royalblue1"     "royalblue2"
## [565] "royalblue3"      "royalblue4"     "saddlebrown"
## [568] "salmon"          "salmon1"        "salmon2"
## [571] "salmon3"         "salmon4"        "sandybrown"
## [574] "seagreen"        "seagreen1"     "seagreen2"
## [577] "seagreen3"      "seagreen4"     "seashell"
## [580] "seashell1"      "seashell2"     "seashell3"
## [583] "seashell4"      "sienna"         "sienna1"
## [586] "sienna2"        "sienna3"        "sienna4"
## [589] "skyblue"         "skyblue1"       "skyblue2"
## [592] "skyblue3"       "skyblue4"       "slateblue"
## [595] "slateblue1"     "slateblue2"     "slateblue3"
## [598] "slateblue4"     "slategray"      "slategray1"
## [601] "slategray2"     "slategray3"     "slategray4"
## [604] "slategrey"      "snow"           "snow1"
## [607] "snow2"          "snow3"          "snow4"
## [610] "springgreen"    "springgreen1"   "springgreen2"
## [613] "springgreen3"   "springgreen4"   "steelblue"
## [616] "steelblue1"     "steelblue2"     "steelblue3"
## [619] "steelblue4"     "tan"            "tan1"
## [622] "tan2"           "tan3"           "tan4"
## [625] "thistle"        "thistle1"       "thistle2"
## [628] "thistle3"       "thistle4"       "tomato"
## [631] "tomato1"        "tomato2"        "tomato3"
## [634] "tomato4"        "turquoise"      "turquoise1"
## [637] "turquoise2"     "turquoise3"     "turquoise4"
## [640] "violet"         "violetred"      "violetred1"
## [643] "violetred2"     "violetred3"     "violetred4"
## [646] "wheat"          "wheat1"         "wheat2"
## [649] "wheat3"         "wheat4"         "whitesmoke"
## [652] "yellow"         "yellow1"        "yellow2"
## [655] "yellow3"        "yellow4"        "yellowgreen"

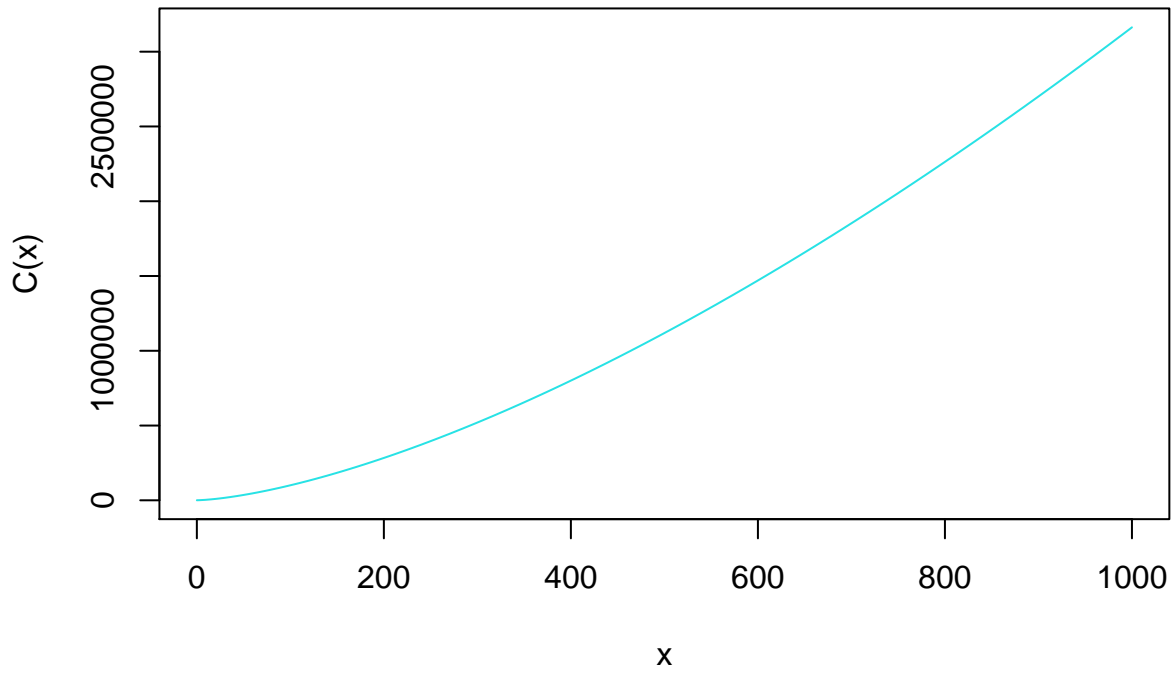
```

```
plot(x, C(x), type = 'b', col = 2)
```

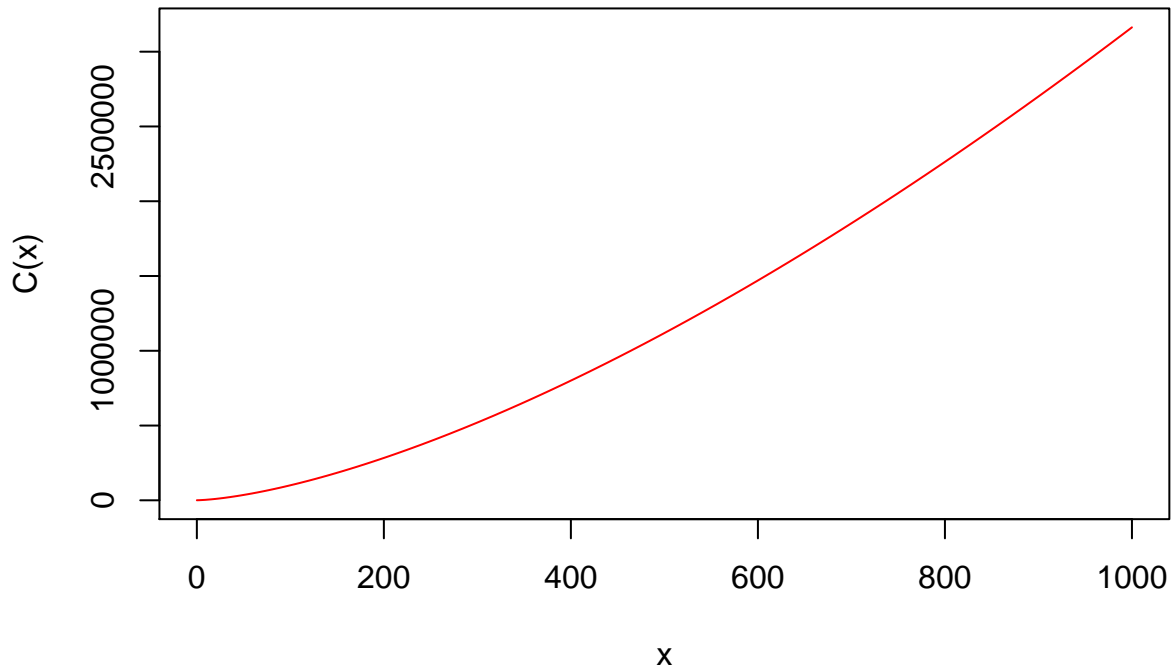
```
x <- 0:1000
plot(x, C(x), type = "l", col = 5) # compare with the previous - both ' and " are accepted; colors can
# set a title on top of the plot
title("Some weird function")
```

Some weird function



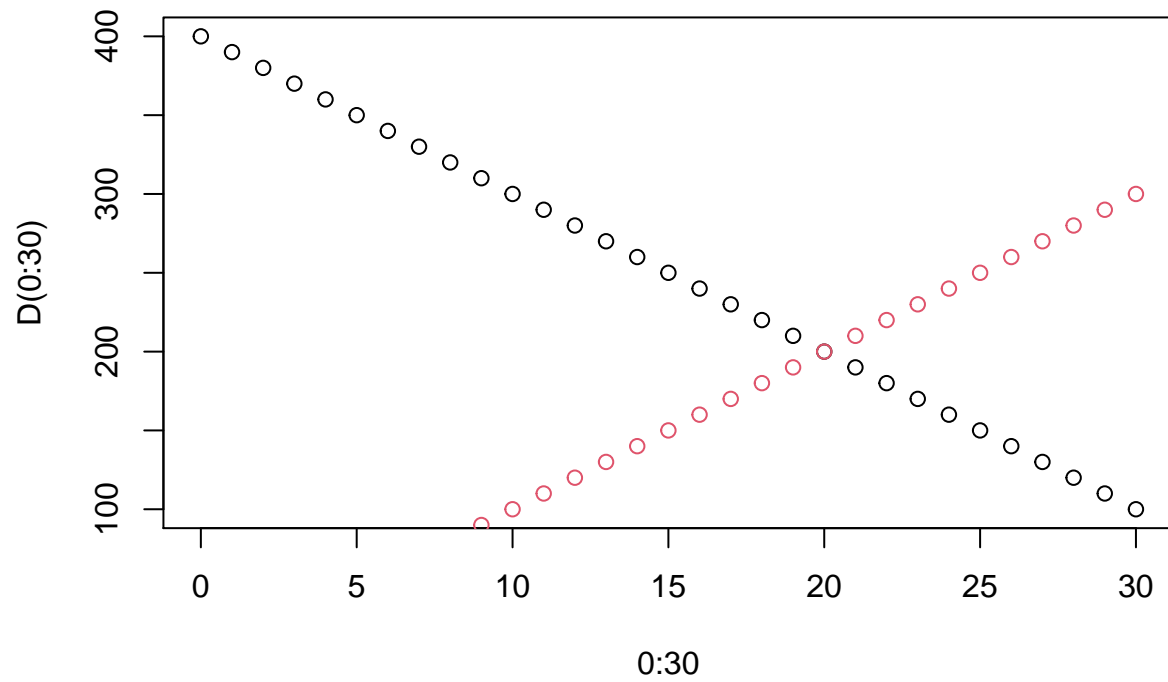
```
plot(x, C(x), type = 'l', col = 'red', main = 'Some weird function')
```

Some weird function

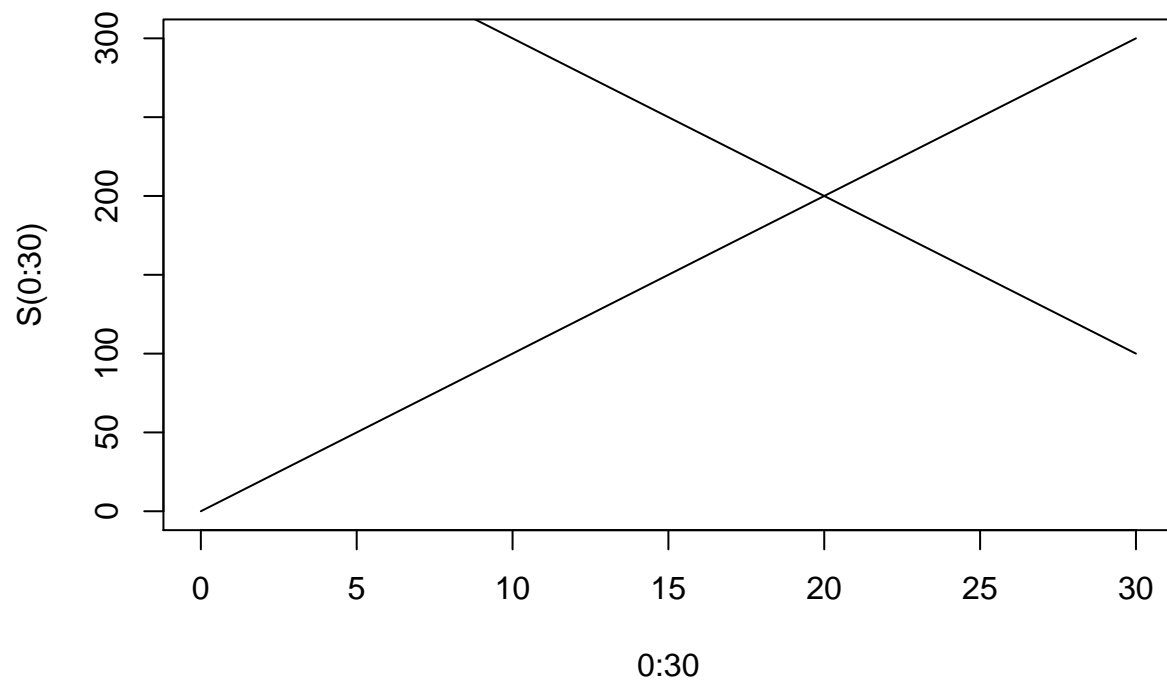


ADDING LINES TO A PLOT:

```
# compare example on slides 13-15,  
# define and plot the demand and supply functions D and S  
D <- function(P) { -10 * P + 400 }  
plot(0:30, D(0:30))  
S <- function(P) { 10*P }  
# add a plot of the supply function,  
# (plot points (p,S(p)) for p = 0,...,30)  
points(0:30, S(0:30), col = 2)
```



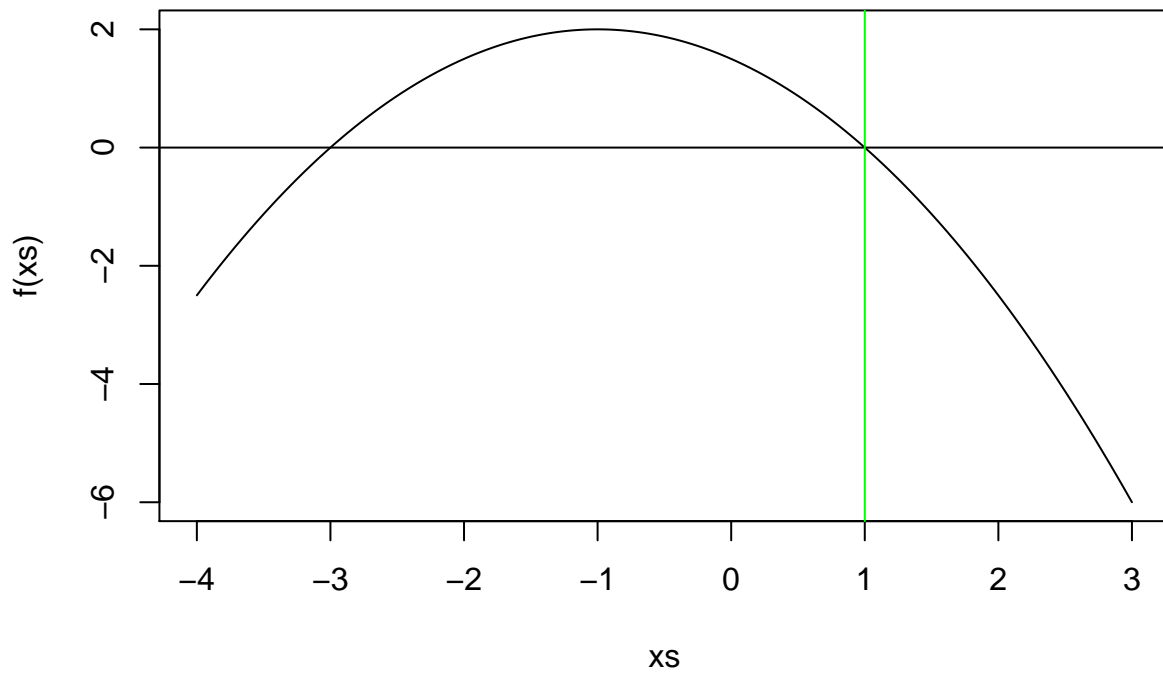
```
plot(0:30, S(0:30), type = 'l')  
# add a plot of the demand function,  
# (plot line segments between points (p,D(p)) for p = 0,...,30)  
lines(0:30, D(0:30))
```



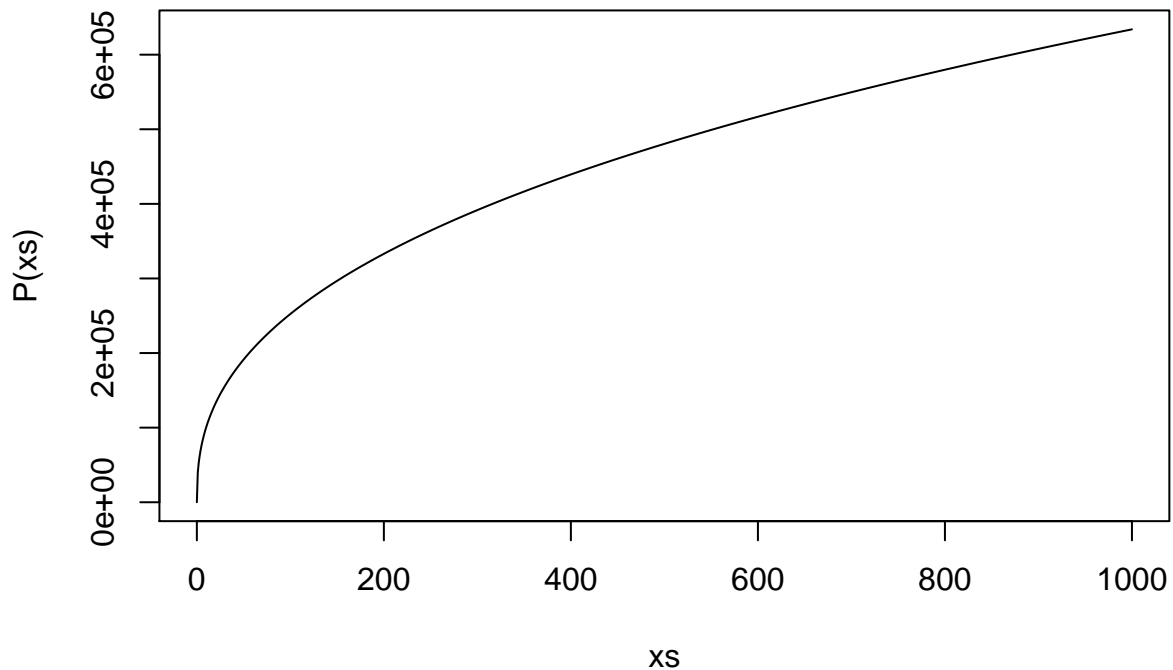
```
# compare example on slide 20
f <- function(x) { -.5 * x^2 - x + 1.5 }
xs <- seq(-4, 3, .01)
plot(xs, f(xs), type = 'l')

# add a straight horizontal line at y = 0
abline(h = 0)

# add a straight vertical line at x = 1 in green color
abline(v = 1, col = "green")
```



```
# compare example on slide 24  
P <- function(s) { 40000 * s.4 }; xs <- 0:1000  
plot(xs, P(xs), type = 'l')
```



```
# compare example on slide 35, double capital at interest rate i
i <- c(1:7)
log(2) / log(1 + i/100)
```

```
## [1] 69.66072 35.00279 23.44977 17.67299 14.20670 11.89566 10.24477
```

```
# rule of 70
70/i
```

```
## [1] 70.00000 35.00000 23.33333 17.50000 14.00000 11.66667 10.00000
```

DEFINE A FUNCTION WITH DEFAULT VALUES

```
# Define a linear function of x, called linfun, with parameters a, b
# set a = 0, b = 0 as default values
linfun <- function(x, a = 0, b = 0) { a*x + b }
```

```
# print objective values of linfun at x = 1,...,5 where
```

```
# a = 1, b = 2
linfun(1:5, 1, 2)
```

```
## [1] 3 4 5 6 7
```

```
linfun(1:5, a = 1, b = 2)
```

```
## [1] 3 4 5 6 7
```

```
# a = 2, b = 1
linfun(1:5, a = 2, b = 1)
```

```
## [1] 3 5 7 9 11  
# a = 0, b = 0 by default  
linfun(1:5)
```

```
## [1] 0 0 0 0 0  
# a = 0 y default, set b = 1  
linfun(1:5, b = 1)
```

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