hwk3.R

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# M348 - hwk 3 - feb. 11 2016

# fixed point iteration
# inputs:
#   pinit: initial approximation
#   tol: tolerance level of error
#   n: max number of iterations
#   gfunc: function to iterate over
fpi<-function(pinit,tol,n,gfunc){

  # as the output is longer I decided to format it neater in a matrix
  final<-matrix(rep(0,n*4), nrow=n)
  colnames(final)<-c('iteration', 'p=g(p0)', 'p0', 'difference')

  # initialize counter
  k<-1

  # preserve initial guess
  p0<-pinit

  # while loop to iterate up to n times
  while (k<=n){

    # find g(p) for current iteration
    p<-gfunc(p0)

    # if found or error within tolerance then output and exit
    if (abs(p-p0)<tol){

      # vector of outputs (iteration #, p=g(p0), p0, abs(p-p0) )
      output<-c(k,p,p0,abs(p-p0))
      final[k,]<-output
      return (final[1:k,])
    }

    # record current output
    output<-c(k,p,p0,abs(p-p0))
    final[k,]<-output

    # update p0
    p0<-p

    # iterate counter
    k<-k+1
  }
```

```
  # record last result
  output<-c(k,p,p0,abs(p-p0))
  final[k,]<-output
  return (final)
}

# create input function to be iterated over
# note: x=tan(x) -> x=arctan(x)=g(x)
g<-function(x){
  return (atan(x))
}

# run the fixed point iteration function with:
#   rearranged function g=arctan(x)
#   inital guess is 3/2*pi=4.7123 which is on [4,5]
#   with error limit 10e-05 for 1000 iterations
result<-fpi(3/2*pi,10e-05,1000,g)

print(result[1:10,])
```

```
##       iteration   p=g(p0)        p0 difference
##  [1,]         1 1.3616917 4.7123890 3.35069730
##  [2,]         2 0.9373668 1.3616917 0.42432490
##  [3,]         3 0.7530804 0.9373668 0.18428641
##  [4,]         4 0.6454696 0.7530804 0.10761074
##  [5,]         5 0.5731838 0.6454696 0.07228580
##  [6,]         6 0.5204683 0.5731838 0.05271552
##  [7,]         7 0.4798879 0.5204683 0.04058046
##  [8,]         8 0.4474288 0.4798879 0.03245903
##  [9,]         9 0.4207137 0.4474288 0.02671515
## [10,]        10 0.3982345 0.4207137 0.02247918
```

```
print(result[327:337,])
```

```
##       iteration    p=g(p0)         p0   difference
##  [1,]       327 0.06783973 0.06794399 1.042632e-04
##  [2,]       328 0.06773594 0.06783973 1.037849e-04
##  [3,]       329 0.06763263 0.06773594 1.033101e-04
##  [4,]       330 0.06752979 0.06763263 1.028390e-04
##  [5,]       331 0.06742742 0.06752979 1.023715e-04
##  [6,]       332 0.06732551 0.06742742 1.019074e-04
##  [7,]       333 0.06722407 0.06732551 1.014469e-04
##  [8,]       334 0.06712308 0.06722407 1.009898e-04
##  [9,]       335 0.06702254 0.06712308 1.005362e-04
## [10,]       336 0.06692245 0.06702254 1.000859e-04
## [11,]       337 0.06682281 0.06692245 9.963902e-05
```