Here are frequency polygons, with bandwidth equal to the IQR divided by the fifth root of $n$.

> set.seed(11091951)
> n <- 10^2
> x <- rnorm(n)
> binwidth <- IQR(x) * (n^(-1/5))
> nbin <- round((max(x) - min(x))/binwidth)
> out <- hist(x, breaks = nbin, plot = FALSE)
> xcoords <- out$mids
> ycoords <- out$density
> start <- xcoords[1]
> finish <- xcoords[length(xcoords)]
> xcoords <- c(start - width, xcoords, finish + width)
> ycoords <- c(0, ycoords, 0)
> plot(xcoords, ycoords, type = "l", main = as.character(n))
> abline(h = 0)

*http://www.math.leidenuniv.nl/~gill/teaching/statistics*
```r
> set.seed(11091951)
> n <- 10^3
> x <- rnorm(n)
> binwidth <- IQR(x) * (n^(-1/5))
> nbin <- round((max(x) - min(x))/binwidth)
> out <- hist(x, breaks = nbin, plot = FALSE)
> xcoords <- out$mids
> ycoords <- out$density
> start <- xcoords[1]
> finish <- xcoords[length(xcoords)]
> xcoords <- c(start - width, xcoords, finish + width)
> ycoords <- c(0, ycoords, 0)
> plot(xcoords, ycoords, type = "l", main = as.character(n))
> abline(h = 0)
```
```r
> set.seed(11091951)
> n <- 10^4
> x <- rnorm(n)
> binwidth <- IQR(x) * (n^(-1/5))
> nbins <- round((max(x) - min(x))/binwidth)
> out <- hist(x, breaks = nbins, plot = FALSE)
> xcoords <- out$mids
> ycoords <- out$density
> start <- xcoords[1]
> finish <- xcoords[length(xcoords)]
> xcoords <- c(start - width, xcoords, finish + width)
> ycoords <- c(0, ycoords, 0)
> plot(xcoords, ycoords, type = "l", main = as.character(n))
> abline(h = 0)
```
```r
> set.seed(11091951)
> n <- 10^5
> x <- rnorm(n)
> binwidth <- IQR(x) * (n^(-1/5))
> nbin <- round((max(x) - min(x))/binwidth)
> out <- hist(x, breaks = nbin, plot = FALSE)
> xcoords <- out$mids
> ycoords <- out$density
> start <- xcoords[1]
> finish <- xcoords[length(xcoords)]
> xcoords <- c(start - width, xcoords, finish + width)
> ycoords <- c(0, ycoords, 0)
> plot(xcoords, ycoords, type = "l", main = as.character(n))
> abline(h = 0)
```
> set.seed(11091951)
> n <- 10^6
> x <- rnorm(n)
> binwidth <- IQR(x) * (n^(-1/5))
> nbin <- round((max(x) - min(x))/binwidth)
> out <- hist(x, breaks = nbin, plot = FALSE)
> xcoords <- out$mids
> ycoords <- out$density
> start <- xcoords[1]
> finish <- xcoords[length(xcoords)]
> xcoords <- c(start - width, xcoords, finish + width)
> ycoords <- c(0, ycoords, 0)
> plot(xcoords, ycoords, type = "l", main = as.character(n))
> abline(h = 0)
> set.seed(11091951)
> n <- 10^7
> x <- rnorm(n)
> binwidth <- IQR(x) * (n^(-1/5))
> nbin <- round((max(x) - min(x))/binwidth)
> out <- hist(x, breaks = nbin, plot = FALSE)
> xcoords <- out$mids
> ycoords <- out$density
> start <- xcoords[1]
> finish <- xcoords[length(xcoords)]
> xcoords <- c(start - width, xcoords, finish + width)
> ycoords <- c(0, ycoords, 0)
> plot(xcoords, ycoords, type = "l", main = as.character(n))
> abline(h = 0)
```r
> set.seed(11091951)
> n <- 10^8
> x <- rnorm(n)
> binwidth <- IQR(x) * (n^(-1/5))
> nbin <- round((max(x) - min(x))/binwidth)
> out <- hist(x, breaks = nbin, plot = FALSE)
> xcoords <- out$mids
> ycoords <- out$density
> start <- xcoords[1]
> finish <- xcoords[length(xcoords)]
> xcoords <- c(start - width, xcoords, finish + width)
> ycoords <- c(0, ycoords, 0)
> plot(xcoords, ycoords, type = "l", main = as.character(n))
> abline(h = 0)
```
After this I wanted to try \( n = 10^9 \). At the command line you get:

```r
> x<-rnorm(10^9)
Error in rnorm(10^9) : cannot allocate vector of length 1000000000
```

But it seems that Sweave crashed earlier, it could not convert `freqpoly-007.eps` to `pdf`. The corresponding `pdf` file was unreadable, though the `postscript` file was fine (the figure above was obtained by doing the conversion “by hand” after the `sweave` job had finished). Here is my `sweave` output:

Processing code chunks ...
...  
...  
6 : echo term verbatim eps pdf  
7 : echo term verbatim eps pdf  
R(1273) malloc: *** mmap(size=800002048) failed (error code=12)  
*** error: can't allocate region  
*** set a breakpoint in malloc_error_break to debug  
R(1273) malloc: *** mmap(size=800002048) failed (error code=12)  
*** error: can't allocate region  
*** set a breakpoint in malloc_error_break to debug  
Error : cannot allocate vector of size 762.9 Mb  
Error in driver$runcode(drobj, chunk, chunkopts) :  
  Error : cannot allocate vector of size 762.9 Mb  
Calls: Sweave -> <Anonymous>  
Execution halted

Inspection of `freqpoly.tex` suggests that `sweave` never got around to \( n = 10^9 \).