

# Summary statistics

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## Brief description of the script

This R markdown document computes the output data of the resulting CSV file from the computing ISO 25178-2 parameters in ConfoMap. These data is part of the manuscript: *Dubreuil et al. A 'family of wear': Exploring use-wear patterns on ad hoc burnishing tools*

It computes the following statistics:

- n (sample size = `length`): number of measurements
- smallest value (`min`)
- largest value (`max`)
- mean
- median
- standard deviation (`sd`)

This R project and respective scripts follow the procedures described by Marwick et al. 2017.

The authors would like to thank Ivan Calandra and Lisa Schunk for their help and contribution on several chunks of code included here in the script (pieces of code are also adapted from Calandra et al. 2019, Pedergrana et al. 2020a, 2020b).

To compile this markdown document do not delete or move files from their original folders.

For any questions, comments and inputs, please contact:

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## Load packages

```
library(openxlsx)
library(R.utils)
library(tools)
library(doBy)

dir_in <- "analysis/derived_data/"
dir_out <- "analysis/summary_stats/"
```

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## Get names, path and information of all files

```
data_file <- list.files(dir_in, pattern = "\\..Rbin$", full.names = TRUE)
md5_in <- md5sum(data_file)
```

## Load data into R object

```
imp_data <- loadObject(data_file)
str(imp_data)
```

```
'data.frame':  30 obs. of  53 variables:
 $ Sample.ID      : chr  "Kremasti4" "Kremasti4" "Kremasti4" "Kremasti4" ...
 $ Microscope     : chr  "LSM" "LSM" "LSM" "LSM" ...
 $ Objective      : chr  "50x" "50x" "50x" "50x" ...
 $ PolishType     : chr  "natural" "natural" "natural" "natural" ...
 $ Surface        : chr  "a" "b" "c" "d" ...
 $ Topo           : chr  "Topo" "Topo" "Topo" "Topo" ...
 $ Acquisition.Date : chr  "2021/04/15" "2021/04/15" "2021/04/15" "2021/04/15" ...
 $ Analysis.Date   : chr  "14:06:02" "14:08:39" "14:11:12" "14:13:40" ...
 $ Analysis.Time   : chr  "4/15/2021 10:24:41 AM" "4/15/2021 10:51:24 AM" "4/15/2021 11:45:47 AM" ...
 $ Axis.length.X   : num  255 255 255 255 255 ...
 $ Axis.size.X     : num  3000 3000 3000 3000 3000 3000 3000 3000 3000 3000 ...
 $ Axis.spacing.X  : num  85.2 85.2 85.2 85.2 85.2 ...
 $ Axis.length.Y   : num  255 255 255 255 255 ...
 $ Axis.size.Y     : num  3000 3000 3000 3000 3000 3000 3000 3000 3000 3000 ...
 $ Axis.spacing.Y  : num  85.2 85.2 85.2 85.2 85.2 ...
 $ Axis.length.Z   : num  40.7 49.9 92.6 31.8 29.3 ...
 $ Axis.size.Z     : num  65532 65532 65531 65532 65531 ...
 $ Axis.spacing.Z  : num  0.621 0.761 1.413 0.485 0.447 ...
 $ NM.points.ratio.Z : num  0 0 0 0 0 0 0 0 0 0 ...
 $ Sq             : num  1.58 4.09 1.47 2.24 1.77 ...
 $ Ssk            : num  -0.61 -0.391 -0.274 -0.049 -0.929 ...
 $ Sku            : num  4.88 2.53 6.23 3.44 5.87 ...
 $ Sp             : num  5.47 10.44 5.15 9.02 7.91 ...
 $ Sv             : num  6.86 12.48 8.2 7.06 8.52 ...
 $ Sz             : num  12.3 22.9 13.4 16.1 16.4 ...
 $ Sa             : num  1.13 3.4 1.08 1.77 1.25 ...
 $ Smr            : num  0.484 0.239 0.604 0.207 0.126 ...
 $ Smc            : num  1.69 4.56 1.72 2.87 1.66 ...
 $ Sxp            : num  3.99 9.02 2.67 4.65 4.7 ...
 $ Sal            : num  19.5 32.4 23.5 30.6 20.7 ...
 $ Str            : num  0.48 NA NA 0.614 0.813 ...
 $ Std            : num  42.2 93.2 33 25.3 62 ...
 $ Sdq            : num  0.383 0.658 0.521 0.403 0.403 ...
 $ Sdr            : num  6 15.94 8.53 6.73 6.56 ...
 $ Vm             : num  0.0895 0.1529 0.1057 0.0994 0.0945 ...
```

```

$ Vv          : num  1.78 4.72 1.82 2.97 1.75 ...
$ Vmp         : num  0.0895 0.1529 0.1057 0.0994 0.0945 ...
$ Vmc         : num  1.13 4.14 1.09 1.84 1.28 ...
$ Vvc         : num  1.5 4.24 1.65 2.68 1.41 ...
$ Vvv         : num  0.287 0.478 0.17 0.292 0.343 ...
$ Maximum.depth.of.furrows: num  7.22 10.88 9.43 6.76 8.68 ...
$ Mean.depth.of.furrows  : num  1.57 3.13 1.47 1.9 1.54 ...
$ Mean.density.of.furrows: num  3750 3056 4011 3480 3423 ...
$ First.direction       : num  89.9772 90.014 45.0229 0.0123 44.9941 ...
$ Second.direction      : num  45 135 180 26.5 63.5 ...
$ Third.direction       : num  180 45 33.7 90 90 ...
$ Texture.isotropy      : num  74 82.7 77.8 90.3 92.3 ...
$ epLsar               : num  NA NA NA NA NA NA NA NA NA NA ...
$ NewEplsar            : num  NA NA NA NA NA NA NA NA NA NA ...
$ Asfc                 : num  9.93 25.92 17.49 11.21 10.47 ...
$ Smfc                 : num  6281985 10723090 4628049 7318909 11574299 ...
$ HAsfc9               : num  0.539 0.39 1.927 0.603 0.546 ...
$ HAsfc81              : num  0.87 0.638 2.369 0.728 0.848 ...

```

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## Define numeric variables

```
num.var <- 21:length(imp_data)
```

The following variables will be used:

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## Compute summary statistics

### Create function to compute the statistics at once

```

nminmaxmeanmedsd <- function(x){
  y <- x[!is.na(x)]
  n_test <- length(y)
  min_test <- min(y)
  max_test <- max(y)
  mean_test <- mean(y)
  med_test <- median(y)
  sd_test <- sd(y)
  out <- c(n_test, min_test, max_test, mean_test, med_test, sd_test)
  names(out) <- c("n", "min", "max", "mean", "median", "sd")
  return(out)
}

```

## Compute the summary statistics in groups

```
s_it <- summaryBy(~ Sample.ID + Impression.Time,  
  data = imp_data[c("Sample.ID", "PolishType", names(imp_data)[num.var])],  
  FUN = nminmaxmeanmedsd)
```

Warning in min(y): no non-missing arguments to min; returning Inf

Warning in max(y): no non-missing arguments to max; returning -Inf

Warning in min(y): no non-missing arguments to min; returning Inf

Warning in max(y): no non-missing arguments to max; returning -Inf

Warning in min(y): no non-missing arguments to min; returning Inf

Warning in max(y): no non-missing arguments to max; returning -Inf

Warning in min(y): no non-missing arguments to min; returning Inf

Warning in max(y): no non-missing arguments to max; returning -Inf

```
str(s_it)
```

```
'data.frame':  2 obs. of  199 variables:  
 $ Sample.ID      : chr  "Kremasti4" "MudPlaster2015MEGII"  
 $ Ssk.n          : num  15 15  
 $ Ssk.min        : num  -3.1 -1.7  
 $ Ssk.max        : num  -0.049 -0.205  
 $ Ssk.mean       : num  -1.145 -0.605  
 $ Ssk.median     : num  -0.994 -0.426  
 $ Ssk.sd         : num  0.8 0.445  
 $ Sku.n          : num  15 15  
 $ Sku.min        : num  2.53 2.62  
 $ Sku.max        : num  21.2 7.62  
 $ Sku.mean       : num  8.62 4.06  
 $ Sku.median     : num  7.07 3.42  
 $ Sku.sd         : num  5.57 1.61  
 $ Sp.n          : num  15 15  
 $ Sp.min        : num  0.715 1.59  
 $ Sp.max        : num  10.4 10.7  
 $ Sp.mean       : num  4.45 4.1  
 $ Sp.median     : num  3.61 2.31  
 $ Sp.sd         : num  2.93 2.95  
 $ Sv.n          : num  15 15  
 $ Sv.min        : num  1.55 2.29  
 $ Sv.max        : num  12.5 12  
 $ Sv.mean       : num  6.4 5.53  
 $ Sv.median     : num  7.06 5.13  
 $ Sv.sd         : num  2.82 3.41
```

\$ Sz.n	: num	15 15
\$ Sz.min	: num	2.26 4.11
\$ Sz.max	: num	22.9 22.7
\$ Sz.mean	: num	10.86 9.63
\$ Sz.median	: num	11.1 7
\$ Sz.sd	: num	5.46 6.25
\$ Sa.n	: num	15 15
\$ Sa.min	: num	0.195 0.445
\$ Sa.max	: num	3.4 3.29
\$ Sa.mean	: num	0.94 1.17
\$ Sa.median	: num	0.704 0.669
\$ Sa.sd	: num	0.804 0.908
\$ Smr.n	: num	15 15
\$ Smr.min	: num	0.126 0.183
\$ Smr.max	: num	88 26.7
\$ Smr.mean	: num	8.36 5.14
\$ Smr.median	: num	0.604 1.069
\$ Smr.sd	: num	22.65 7.63
\$ Smc.n	: num	15 15
\$ Smc.min	: num	0.309 0.658
\$ Smc.max	: num	4.56 4.8
\$ Smc.mean	: num	1.38 1.77
\$ Smc.median	: num	0.968 0.905
\$ Smc.sd	: num	1.1 1.38
\$ Sxp.n	: num	15 15
\$ Sxp.min	: num	0.571 1.408
\$ Sxp.max	: num	9.02 9.46
\$ Sxp.mean	: num	3.16 3.47
\$ Sxp.median	: num	2.88 2.52
\$ Sxp.sd	: num	2.14 2.56
\$ Sal.n	: num	15 15
\$ Sal.min	: num	16.2 14.9
\$ Sal.max	: num	32.4 29.2
\$ Sal.mean	: num	21.7 22.2
\$ Sal.median	: num	20 20.9
\$ Sal.sd	: num	5.03 4.44
\$ Str.n	: num	13 11
\$ Str.min	: num	0.24 0.179
\$ Str.max	: num	0.813 0.847
\$ Str.mean	: num	0.62 0.511
\$ Str.median	: num	0.69 0.551
\$ Str.sd	: num	0.17 0.237
\$ Std.n	: num	15 15
\$ Std.min	: num	25.25 3.25
\$ Std.max	: num	148 177
\$ Std.mean	: num	60.8 71
\$ Std.median	: num	42.2 37.8
\$ Std.sd	: num	36.3 64.3
\$ Sdq.n	: num	15 15
\$ Sdq.min	: num	0.113 0.147
\$ Sdq.max	: num	0.658 0.688
\$ Sdq.mean	: num	0.31 0.309
\$ Sdq.median	: num	0.27 0.178
\$ Sdq.sd	: num	0.148 0.204

```

$ Sdr.n           : num  15 15
$ Sdr.min         : num  0.601 1.04
$ Sdr.max         : num  15.9 16.6
$ Sdr.mean        : num  4.55 5.21
$ Sdr.median      : num  2.85 1.5
$ Sdr.sd          : num  3.95 5.87
$ Vm.n            : num  15 15
$ Vm.min          : num  0.00964 0.02037
$ Vm.max          : num  0.153 0.177
$ Vm.mean         : num  0.0666 0.0571
$ Vm.median       : num  0.059 0.0268
$ Vm.sd           : num  0.0407 0.0491
$ Vv.n            : num  15 15
$ Vv.min          : num  0.319 0.681
$ Vv.max          : num  4.72 4.98
$ Vv.mean         : num  1.44 1.83
$ Vv.median       : num  1.08 0.925
$ Vv.sd           : num  1.13 1.43
$ Vmp.n           : num  15 15
$ Vmp.min         : num  0.00964 0.02037
[1] list output truncated

```

---

## Save data

### Format name of output file

```
file_out <- "datastats"
```

The file will be saved as “~/analysis/summary\_stats/datastats.[ext]”.

### Write to XLSX

```
write.xlsx(list(Sample_ImpTime = s_it), file = paste0(dir_out, file_out, ".xlsx"))
```

### Save R object

```
saveObject(s_it, file = paste0(dir_out, file_out, ".Rbin"))
```

---

## sessionInfo() and RStudio version

```
sessionInfo()
```

```
R version 4.0.4 (2021-02-15)  
Platform: x86_64-apple-darwin17.0 (64-bit)  
Running under: macOS Catalina 10.15.7
```

```
Matrix products: default
```

```
BLAS: /Library/Frameworks/R.framework/Versions/4.0/Resources/lib/libRblas.dylib
```

```
LAPACK: /Library/Frameworks/R.framework/Versions/4.0/Resources/lib/libRlapack.dylib
```

```
locale:
```

```
[1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
```

```
attached base packages:
```

```
[1] tools      stats      graphics  grDevices  utils      datasets  methods  
[8] base
```

```
other attached packages:
```

```
[1] doBy_4.6.9      R.utils_2.10.1  R.oo_1.24.0     R.methodsS3_1.8.1  
[5] openxlsx_4.2.3
```

```
loaded via a namespace (and not attached):
```

```
[1] zip_2.1.1      Rcpp_1.0.6      bslib_0.2.4     compiler_4.0.4  
[5] pillar_1.6.0   jquerylib_0.1.3 digest_0.6.27    lattice_0.20-41  
[9] gtable_0.3.0   jsonlite_1.7.2  evaluate_0.14    lifecycle_1.0.0  
[13] tibble_3.1.1   pkgconfig_2.0.3 rlang_0.4.10     Matrix_1.3-2  
[17] DBI_1.1.1      yaml_2.2.1      xfun_0.22        dplyr_1.0.5  
[21] stringr_1.4.0  knitr_1.32       generics_0.1.0   vctrs_0.3.7  
[25] sass_0.3.1     grid_4.0.4      rprojroot_2.0.2  tidyselect_1.1.0  
[29] glue_1.4.2     R6_2.5.0        fansi_0.4.2      rmarkdown_2.7  
[33] tidyr_1.1.3    ggplot2_3.3.3   purrr_0.3.4      magrittr_2.0.1  
[37] backports_1.2.1 MASS_7.3-53.1    scales_1.1.1     htmltools_0.5.1.1  
[41] ellipsis_0.3.1 assertthat_0.2.1 colorspace_2.0-0 Deriv_4.1.3  
[45] utf8_1.2.1     stringi_1.5.3   munsell_0.5.0    broom_0.7.6  
[49] crayon_1.4.1
```