---

title: "How R helped me with time motion analysis"

subtitle: "HAT"

author: "Benjamin Chow"

output:

xaringan::moon\_reader:

lib\_dir: libs

css: [default, hygge, ninjutsu]

nature:

ratio: 16:9

highlightStyle: github

highlightLines: true

countIncrementalSlides: false

---

```{r, include = F}

# This is the recommended set up for flipbooks

knitr::opts\_chunk$set(message = FALSE, warning = FALSE, comment = "", cache = F)

library(flipbookr)

library(tidyverse)

library(lubridate)

library(bupaR)

```

# Outline

- ### What is time motion study?

- ### What kind of analysis can I do in a time motion study?

- ### Why I should it in `R`?

- ### How I can I do it in `R`?

---

class: inverse, middle, center

# What is time motion study?

<img src="what is tms.png" widith= "90%"/>

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# Example of workflow/ "motion" element of time motion study

### Workflow of patients being admitted (artifical data)

```{r echo=F}

activity\_labels(patients)

```

### There can be different permutations and combinations for a work process

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```{r eventlog, include=F}

patients\_df<-tibble(patients)

patients\_df %>% select(.order, handling, registration\_type, time) %>%

left\_join(patients\_df %>% select(patient, .order), by=".order") %>%

left\_join(patients\_df %>% select(employee, .order), by=".order")

```

`r chunk\_reveal("eventlog", display\_type = "output", title = "# How to collect data for time motion study")`

---

### When data is more than \_time\_ and \_motion\_, the analysis becomes more of process mining/process analysis

```{r echo=F}

mapping(patients)

```

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### For simplicity, we'll call it time motion study

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# Where to collect data for time motion study?

- ### Observational Study

- ### Self reporting

- ### Logs from IT system

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## Why time motion study?

- ### Uncover the sequencing of activities in workflow

- ### Identify bottlenecks

- ### Identify outliers when compared against a theoretical workflow model

- ### Examine the relationship between resource providers

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## [What did my department use it for?](https://github.com/notast/Time-Motion-Study/blob/main/Conference%20Presentation\_Time-motion%20analysis%20for%20productivity.pdf)

1. #### Proportion of inappropriate referrals

2. #### Total duration for case management (Face to face and non face to face activities)

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---

`r chunk\_reveal("why\_R\_1", widths=c(40, 60), title = "### 1. Add comments as you formulate your analysis")`

```{r why\_R\_1, include=F}

# Boss ONLY wants

# 1 Day of week

# 2 Month

# 3 Year

patients\_df %>% tail(1) %>%

select(time) %>%

mutate(

# 1 Day of week

DOW= wday(time, abbr = T),

# 2 Month

Month= month(time, abbr = T),

# 3 Year

Year= year(time),

# keep none of the original columns

.keep="none")

```

---

`r chunk\_reveal("why\_R\_2", title = "### 2. Analysis doesn't change if you relocate your columns")`

```{r why\_R\_2, include=F}

patients\_df %>% tail(1) %>%

relocate(time, 1) %>%

mutate(DOW= wday(time, abbr = T),

Month= month(time, abbr = T),

Year= year(time),

.keep="none")

```

---

`r chunk\_reveal("why\_R\_3", break\_type = "rotate", chunk\_options = "fig.width = 13", display\_type = "output", title = "### 3. Stun your boss's with amazing visualizations")`

```{r why\_R\_3, include=F}

patients\_df<-patients\_df %>% mutate(handling= fct\_relevel(handling, "Registration", "Triage and Assessment", "Blood test", "X-Ray", "MRI SCAN", "Discuss Results", "Check-out"))

patients\_df %>% dplyr::mutate(

time= format(time, format = "%H:%M:%S") %>% as.POSIXct(format = "%H:%M:%S"), #standardized the date for ploting

hour= lubridate::floor\_date(time, "hour")) %>% # round down time to nearest hour

count(handling, hour)%>% # total instances of each activity at each hour

add\_count(handling, wt=n) %>% # total instances of each activity

mutate(percent= ((n/nn)\*100)) %>% #relative freq for each activity

ggplot(aes(hour, handling, fill=percent)) + geom\_tile(size=.5, color="white") +

theme\_classic() +

labs(x="24hour Clock", y="", title= "Peak and Lull Period of Patient Activities", subtitle= "percentage calculated is the relative frequency for a specific activity", fill="%") + scale\_y\_discrete(limits = rev(levels(patients\_df$handling)))+ # reverse display of y-axis varaibles

scale\_x\_datetime(date\_breaks = ("1 hour"), date\_labels = "%H") + #display only 24H clock values

scale\_fill\_viridis\_c(option = "magma", alpha=.8) + #ROTATE

scale\_fill\_viridis\_c(option = "cividis", alpha=.8) + #ROTATE

scale\_fill\_viridis\_c(option = "plasma", alpha=.8) #ROTATE

```

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## 4. `R` has packages specific for time motion analysis

- ### `R` packages = mobile apps

- ### primary package [`bupaR`](http://bupar.net/). 7 secondary packages

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- ### all languages have rules including `R`

- ### `bupaR` follows R's `tidyverse` style.

- ### `tidyverse` style adopts pipeline production. step1 `%>%` step2.

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- ### `tidyverse` style is verb heavy.

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- ## Lower barrier of entry for beginners.

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<img src="dplyr\_relocate.png" width= "80%"/>

##### Artwork by @allison\_horst

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<img src="dplyr\_filter.jpg" width= "90%"/>

##### Artwork by @allison\_horst

---

`r chunk\_reveal("why\_R\_4\_MRI", widths=c(45, 55), title = "## bupaR using tidyverse style \n ### patients with MRI scan")`

```{r why\_R\_4\_MRI, include=F}

patients %>%

filter\_activity\_presence("MRI SCAN") %>%

processing\_time(level="log",

units="hours")

```

---

`r chunk\_reveal("why\_R\_4\_noMRI", widths=c(45, 55), title = "## patients without MRI scan")`

```{r why\_R\_4\_noMRI, include=F}

patients %>%

filter\_activity\_presence("MRI SCAN",

method="none") %>%

processing\_time(level="log",

units="hours")

```

---

# 5. One stop shop

<img src="rmarkdown\_rockstar.png" width= "60%"/>

##### Artwork by @allison\_horst

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<img src="rmarkdown\_wizards.png" width= "80%"/>

##### Artwork by @allison\_horst

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# 6. As text/ code/ comments of your analysis are in one place, it is reproducible.

<img src="reproducibility\_court.png" width= "60%"/>

##### Artwork by @allison\_horst

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---

### Boss \_"I heard you attended HAT."\_

--

### You \_"Yeah, why?"\_

--

### Boss \_"There are so many patients coming in at different times and doing different activities. Quite hard to visualize their movements."\_

--

### Boss \_"Can you use your HAT skills to create a flow map from the time patients were admitted to discharge?"\_

---

### Getting you comfortable to use `bupaR` in `R`

<img src="r\_first\_then.png" width= "90%"/>

##### Artwork by @allison\_horst

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# setup

```{r}

# the packages

library(tidyverse)

library(bupaR) # primary

library(processanimateR) # secondary package which is not automatically loaded with bupaR

```

--

```{r eval=F}

# import data

dataset<- read\_csv("file name.csv")

# convert to format recognized by bupaR

dataset\_bupaR\_format<-

dataset %>%

eventlog(

case\_id = "patient",

activity\_id = "activity",

activity\_instance\_id = "activity\_instance",

lifecycle\_id = "status",

timestamp = "timestamp",

resource\_id = "resource"

)

```

---

```{r echo=F}

patients

```

---

# Create a flow map

```{r out.width="90%", out.height="50%"}

patients %>%

process\_map()

```

---

# Animate it

```{r}

patients %>% animate\_process()

```

---

`r chunk\_reveal("animate\_duration", break\_type = "replace", float = "top", replacements = c(60, 30), replace = "60", title="## What does duration do \n https://bupaverse.github.io/processanimateR/reference/animate\_process.html", widths=99)`

```{r animate\_duration, include=F}

patients %>%

animate\_process(duration=60)

```

---

- ### Boss \_"I heard you attended HAT."\_

- ### You \_"Yeah, why?"\_

- ### Boss \_"There are so many patients coming in at different times and doing different activities. Quite hard to visualize their movements."\_

- ### Boss \_"Can you use your HAT skills to create a flow map from the time patients were admitted to discharge?"\_

--

- ### You \_"Here you go boss."\_

---

```{r out.width="90%"}

animate\_process(patients,

#slow down, easier to spot bottleneck

duration=200,

# a colour for each pt

mapping = token\_aes(color = token\_scale("patient",scale = "ordinal", range = RColorBrewer::brewer.pal(12, "Paired"))))

```

---

# Any Questions

<img src="foreveR.jfif" width= "70%"/>

##### Artwork by @allison\_horst