

1. Brisbane City Council maintains more than 2180 parks across Brisbane. The parks range in size from small pocket parks to large district parks, two botanic gardens and many bushland reserves.

The web page

<https://data.gov.au/dataset/ds-brisbane-0335347d-d085-4c5a-a26a-3b92e8bb7a87>

identifies City Council Parks within the Brisbane area. We will use the information about parks' latitude, longitude, and area.

- (a) Use the `READ.CSV` function to read in R the data file `Park_Locations.csv` from the LMS folder `Data`.
 - (b) Create the data frame **bparks** using only complete cases and three features: `"LONG"`, `"LAT"`, and `"SHAPE_Area"`.
 - (c) Add the row numbers as the row names for this data.
 - (d) Use `PROJ4STRING` to assign the projection string with CRS (`" +proj=longlat +datum=WGS84"`).
 - (e) Create the `SpatialPointsDataFrame` **bparks.sp** with the coordinates and sizes of the parks.
 - (f) Convert **bparks.sp** to the `sf` object **bparks.sf**.
 - (g) Use `MAPVIEW` to visualise **bparks.sp**.
 - (h) How many large parks you can identify on the map?
 - (i) Compute coordinates of 5 largest parks.
 - (j) Produce an image with locations of these largest parks connected by straight lines.
 - (k) Combine images from questions 1g and 1j in the same plot.
2. Consider the functions
 - (a) $B(\mathbf{t}_k, \mathbf{t}_l) = 1,$
 - (b) $B(\mathbf{t}_k, \mathbf{t}_l) = \mathbf{t}_k \cdot \mathbf{t}_l,$
 for all $\mathbf{t}_k, \mathbf{t}_l \in T$.
 Use the definition of positive definiteness to show that they are covariance functions.
3. Use the result from 2 and properties of \mathcal{P}_T from the lectures to show that the functions
 - (a) $B(\mathbf{t}_k, \mathbf{t}_l) = 5,$
 - (b) $B(\mathbf{t}_k, \mathbf{t}_l) = 3 \cdot \mathbf{t}_k \cdot \mathbf{t}_l,$
 - (c) $B(\mathbf{t}_k, \mathbf{t}_l) = 5 + 3 \cdot \mathbf{t}_k \cdot \mathbf{t}_l,$

where $\mathbf{t}_k, \mathbf{t}_l \in T$, are covariance functions.

4. Consider the functions

(a) $B(\mathbf{t}_k, \mathbf{t}_l) = -1$,

(b) $B(\mathbf{t}_k, \mathbf{t}_l) = -\mathbf{t}_k \cdot \mathbf{t}_l$,

for all $\mathbf{t}_k, \mathbf{t}_l \in T$.

Use the definition of positive definiteness to show that they are not covariance functions.