School of Mathematics and Statistics
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DATA304/COMP312/DATA474 **Tutorial 3** **Week 3**

Part 1 — Python

1 Define a class, `Square`, with a `side` attribute (the length of the side of the square). This is initialised when a square is created. Give it an `area` method which returns the area of the square and a `diag` method which returns the length of its diagonal. Create a particular Square instance, `q`, with side length 10. Print its area and the length of its diagonal. pyz020

2 (a) Write Python code that defines a `Vehicle` class of objects. Each object has an `id` number (integer) and a `speed` (integer in km/hr) attribute that are set up on creation. The class should have a `__str__` method that returns a string with the word `Vehicle`, its `id` and `speed`.

(b) Define a `Bus` class that inherits from `Vehicle` and has a `passengers` attribute to hold the number of passengers. Override the `__str__` method to include the string `Bus` (in place of `Vehicle`) and the number of passengers as well as the previous information (`id`, `speed`).

(c) Also define a `Truck` class that inherits from `Vehicle` and has a `load` (tonnes) attribute. Again override the `__str__` method to display this new information (including the string `Truck` instead of `Vehicle` or `Bus`).

(d) Create two `Vehicle`s (id 1 and 2, speed 30), two `Bus`es (ids 3 and 4, speed 45, passengers 30 and 40), and two `Truck`s (id 5 and 6, speed 55, load 1 and 2). Put them into a list and print out all the members of the list and their attributes using the `__str__` methods.

pyz039a

3 (a) Write an `erlangvariate(k,lam)` function in Python which generates a random variate from an Erlang(k, λ) distribution. This is simply the sum of k independent exponential random variates Exp(λ) with rate λ.

(b) For each $k \in \{1, 2, 3, 4, 5\}$ and $\lambda \in \{0.2, 0.5, 2.0, 5.0\}$, simulate 10000 random variates $X \sim \text{Erlang}(k, \lambda)$ to estimate $E(X)$ and $\text{var}(X)$. Use `numpy.var()` to estimate $\text{var}(X)$.

(c) Compare your results from parts (b) to the exact values of $E(X) = \frac{k}{\lambda}$ and $\text{var}(X) = \frac{k}{\lambda^2}$.

pyz125

4 (a) Consider a random variable $X \sim U(a, b)$. Simulate 10000 random variates of X to estimate $\text{var}(X)$. Then modify your code to give a 95% confidence interval for $\text{var}(X)$ from 50 replications. Compare your results to the exact value of $\text{var}(X)$ which you can find, e.g., on Wikipedia. Use $X \sim U(2, 5)$ as an example.

(b) Repeat part (a) above using a random variable $X \sim \text{Triangular}(a, b, c)$ as defined at `http://en.wikipedia.org/wiki/Triangular_distribution`. Note that to generate a random variate from a triangular distribution, we follow the method described on the Wikipedia article. Use $X \sim \text{Triangular}(2, 5, 3)$ as an example. pyz126