Colonel Density Estimation

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Abstract

The highly relevant and important problem of Colonel Density Estimation has seen little focus in recent times. In this work, we present fresh approaches to solve both classes of Colonel Density Estimation - Colonel-Density Estimation and Colonel Density-Estimation. The proposed solution is currently the state-of-the art in both classes of the problem. We also discuss how this approach can easily be extended to solve the more General Density Estimation problem.

1 Introduction

Colonel Density Estimation is an important problem in the fields of statistics, physics, biology and military recruitment but has surprisingly got almost no interest from research groups. In contrast, the easier and similar sounding problem of Kernel Density Estimation has seen a significantly disproportionate amount of effort trying to advance the current state-of-art. Recently, [4] suggested the method of diffusion while [12] explained how to go about choosing the kernel and bandwidth.

Figure 1: A colonel

Despite the apparent similarities of the two problems, the methods used for Kernel Density Estimation can't be used for Colonel Density Estimation [11]. Kernel Density Estimation can give only the density of the bones of the colonel, not the whole colonel. Finding the density of a whole colonel is one of the two classes of problems Colonel Density Estimation must solve. Also, while Kernel Density Estimation is a non-parametric method, Colonel Density Estimation is non-paramilitaric. The method suggested in this paper is more akin to generalization when compared to the existing approaches for Kernel Density Estimation.

There are two classes of Colonel Density Estimation. The first, *Colonel-Density Estimation* is the problem of estimating the density of colonels. The second, *Colonel Density-Estimation* involves using colonels for the problem of Density Estimation. In this work, we provide a novel approach for Colonel-Density Estimation that beats all prior research that attempts to solve this problem. For the second problem, we propose a solution that needs much fewer resources when compared to the state-of-the-art.

2 Colonel-Density Estimation

We solve the problem of estimation of the density of colonels by first finding the mass and volume of the colonel and dividing the two quantities to get the density.

2.1 Finding mass

We were disappointed that though several earlier works like [7], [9] , [3] claim to introduce a novel method, they do not actually use any novels. We introduce a novel method that does actually involve novels. Though we are the first to use novels for mass in the context of density estimation, the idea we propose and the novel have been time-tested in a different field for several centuries now.
Inspired by religion where a novel is used for obtaining mass, we let out colonels read out from the same novel. The money raised in the process (but expressed in the SI units of mass) is the mass of the colonel.

2.2 Finding volume

We use the classical method [2] to find the volume of a colonel. The colonel is immersed into a tank filled to the brim with a Newtonian liquid. The volume of the colonel is equal to the volume of the liquid displaced. We experimentally found that better results were achieved when the colonel was immersed for quite a while so that the liquid displaces the air in the lungs of the colonel as well.

2.3 Calculation of density

We calculate density as

$$D = \frac{\text{mass}}{\text{volume}} \tag{1}$$

where the mass and volume are in SI units (when the volume is zero, it would mean that Nishant had probably messed up somewhere.)

2.4 Results

We choose colonels who know their densities for evaluating our performance. The calculated density D of a colonel is correct if it falls between $\hat{D} - \varepsilon$ and $\hat{D} + \varepsilon$ where $\hat{D}$ is the actual density of the colonel. The accuracy of the method is equal to the ratio of the number of correct estimates of density to the total number of colonels who participated in the experiment.

We compare our performance with [8], [1] and [6]. The results are summarized in Figure 2. It is to be observed that we perform significantly better than other methods. We reason that this could be because these earlier works did not intend to solve the problem of Colonel-Density Estimation at all. We leave this for future work to verify.

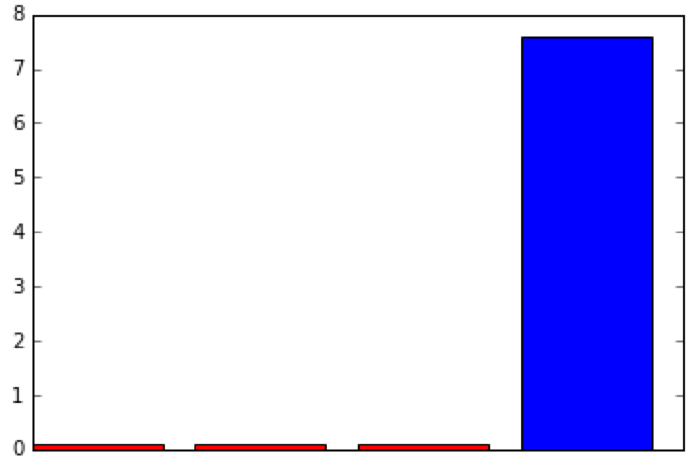

Figure 2: Comparison of accuracies of our method (blue) with respect to other methods (red) for the task of Colonel-Density Estimation

3 Colonel Density-Estimation

There is very limited prior knowledge and experiences in using colonels for density estimation. Colonels, usually found shouting for attention, are easy and efficient tools for density estimation. In our experiments, we found that if we asked a colonel politely to guess the density of an object we were pointing to, the colonel usually obliged. However, evaluation of colonel-based density estimation is hard [5] as the accuracy of the method is so heavily dependent on the choice of colonel and how annoyed the colonel is. This is one similarity this shares with Kernel Density Estimation where the choice of Kernel makes a difference.

Instead, we assert the relevance of our approach by comparing the kind of resources our method needs with prior work that uses colonels for density estimation. The only works that we found that could perhaps give a more accurate estimate of density using a colonel are in [13] and [14]. We believe that the method of just asking the War Machine with Colonel J Rhodes in it has the potential to be more accurate than our method. This is because Jarvis, the Artificial Intelligence that helps control the metal suit, is pretty smart and probably knows the densities of most objects. However, the cost of building such a War Machine or Iron Patriot suit is very high [10] and can only be afforded by billionaires. In comparison, the cost of our suggested method is negligible (refer Figure 4). Also, since Colonel J Rhodes is currently recovering after an injury sustained in a civil war, our colonel-based density estimation technique is the state-of-art, at least until he returns.

Figure 3: Colonel Rhodes and Jarvis, the only competition for Colonel Density-Estimation

4 Generalizability

The solutions to the problem of Colonel Density Estimation proposed in this paper are perhaps among the most easily generalizable solutions ever. This only involves replacing the colonel with a general in every step of each process. We found that in general, generals perform better at density estimation. An interesting observation was that the colonel-density and general-density are different, despite both colonels and generals being humans. We attribute this to the fact that generals are more mean, and hence probably more thick-skinned.

Figure 4: Colonel Rhodes in his War Machine suit was the state-of-art for Colonel Density-Estimation until he was injured.

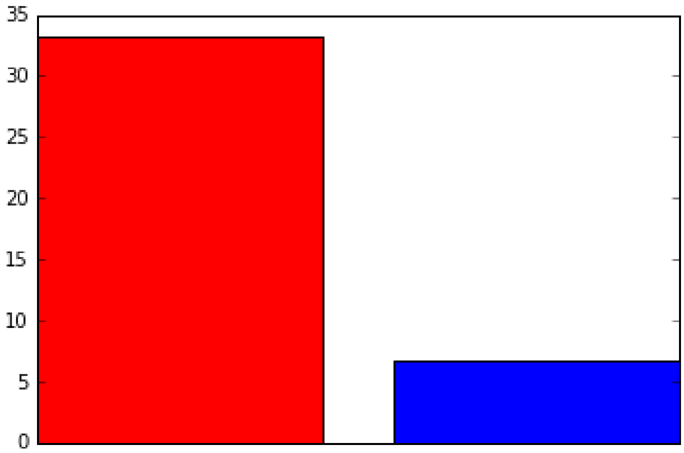

Figure 5: Cost of [14] (red) and our proposed solution (blue) for Colonel-Density Estimation. Note that the y-axis is a logarithmic scale.

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