(i) If $1 \leq p < q \leq 2$ then

$$\text{exact type of } L^p(\mu) = p < \text{exact type of } L^q(\nu) = q,$$

which excludes any isomorphism between $L^p(\mu)$, $L^q(\nu)$.

(ii) If $1 \leq p < 2$, $2 \leq q < \infty$ then

$$\text{exact type of } L^p(\mu) = p < \text{exact type of } L^q(\nu) = 2,$$

which excludes any isomorphism between $L^p(\mu)$, $L^q(\nu)$.

(iii) If $2 \leq p < q < \infty$ then $1 < q' < p' \leq 2$; if $L^p(\mu)$, $L^q(\nu)$ were isomorphic then their duals $L^{p'}(\mu), L^{q'}(\nu)$ would be isomorphic, which is impossible in view of (i).

(iv) If $1 < p < \infty$, $q = \infty$ then $L^p(\mu)$ has exact type equal to $\min(p, 2) > 1$ whereas $L^\infty(\nu)$ has exact type 1; thus $L^p(\mu)$ is not isomorphic to $L^\infty(\nu)$ (a fact which is obvious on the grounds of reflexivity as well).

(v) Finally, let $p = 1$, $q = \infty$; then $L^1(\mu)$ is not isomorphic to $L^\infty(\nu)$ since the exact cotype of $L^1(\mu)$ is 2 and the exact cotype of $L^\infty(\nu)$ is ∞.

This completes the proof of the L^p-isomorphism theorem.

A proof that no infinite dimensional $L^1(\mu)$ can be isomorphic to any $C_0(Y)$ or $C(Y)$ (Y any locally compact Hausdorff space) can be based on the same ideas as (v) above. The exact cotype of $L^1(\mu)$ is 2 whereas the exact cotype of any infinite dimensional $C_0(Y)$ or $C(Y)$ is ∞ (exactly as in the case of $L^\infty(\mu)$). This excludes the possibility of any isomorphism between $L^1(\mu)$ and $C_0(Y)$ or $C(Y)$.

REMARK. The L^p-isomorphism theorem seems to be known to various specialists; however, I know of no explicit formulation or proof of it in complete generality except for that in [C].

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