An introduction to Homotopy QFTs,
talks by Tim Porter.

Summary:

1. Brief 'recall' of simplicial set theory (simplicial sets, simplicial groups, some examples from geometric topology, Moore complexes, homotopy groups etc., bundles and classifying spaces, $\overline{W}$, 'homotopy finite');

2. Crossed modules and crossed complexes; their relation with simplicial groups (2-types and generally n-types). Crossed modules and categorical groups (a special type of strict monoidal category). Nerves for crossed modules, etc. and their relationship with $\overline{W}$;

3. Yetter's construction of TQFTs from a finite crossed module, extension to n-types (1997);

4. Relative theory (1998): $G \to H$ morphism of simplicial groups with sufficiently (homotopy) finite kernel, possibly interesting examples: essentially derived from $PL \to Top$, $O \to PL$, $Spin \to SO$ (other interesting cases???)

5. HQFT (Turaev 1998) then Rodrigues (2000), idea *an HQFT is a TQFT with 'background'*, Theorem of Rodrigues : HQFT based on d-dimensional manifolds with background B, depends only on the $(d+1)$-type of B :
question: *take an algebraic model for an $(d+1)$-type, can we construct a HQFT with background its classifying space? And can we classify these HQFTs?*

6. Classification : Case 1 (Turaev) $B = K(\pi, 1)$, $d = 1$ solution crossed π-algebra;
Case 2. (Brightwell-Turner, 2000) $B = K(A, 2)$, $d = 1$ solution Frobenius algebra with action of A;

7. $1 + 1$-dim FHQFT (so again $d = 1$) (Porter-Turaev, 2003-2005) Crossed $\mathcal{C}$-algebras,

8. Links with relative TQFT situations?

9. HQFTs classify what?

Plan: sections 1-4 in first session, the remainder in the second.