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**One-dimensional topological theories with defects and linear generating functions.** (English)

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*M. Atiyah* [Publ. Math., Inst. Hautes Étud. Sci. 68, 175–186 (1988; Zbl 0692.53053)] gave an axiomatic framework for topological quantum field theories after *G. B. Segal* [NATO ASI Ser., Ser. C 250, 165–171 (1988; Zbl 0657.53060)], listing examples, which can be augmented by nonmonoidal topological theories coming from the universal constructions [*C. Blanchet* et al., Topology 34, No. 4, 883–927 (1995; Zbl 0887.57009); *M. H. Freedman* et al., Geom. Topol. 9, 2303–2317 (2005; Zbl 1129.57035); *M. Khovanov*, “Decorated one-dimensional cobordisms and tensor envelopes of noncommutative recognizable power series”, Preprint, [arXiv:2010.05730](https://arxiv.org/abs/2010.05730); “Universal construction of topological theories in two dimensions”, Preprint, [arXiv:2007.03361](https://arxiv.org/abs/2007.03361); *M. Khovanov* and *R. Sazdanovic*, “Bilinear pairings on two-dimensional cobordisms and generalizations of the Deligne category”, Preprint, [arXiv:2007.11640](https://arxiv.org/abs/2007.11640)], where one starts with an evaluation of closed  $n$ -manifolds to elements of the ground field and associate state spaces to closed  $(n - 1)$ -manifolds and maps between spaces to cobordisms between them. The resulting theories are interesting even in one dimension if manifolds are enriched by defects, such as submanifolds or other decorations. In one dimension, defects are zero-dimensional submanifolds that may carry additional labels. Universal theories in this case relate to noncommutative power series. This paper studies the Gram determinant and constructs bases for the one-dimensional topological theory of decorated unoriented one-dimensional cobordisms, when the pair of generating functions is linear.

Reviewer: [Hirokazu Nishimura \(Tsukuba\)](#)

**MSC:**

[18M30](#) String diagrams and graphical calculi

[05A15](#) Exact enumeration problems, generating functions

[57K16](#) Finite-type and quantum invariants, topological quantum field theories (TQFT)

**Keywords:**

topological quantum field theory; cobordism; universal construction; string diagrams; defects; evaluations; linear generating functions

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